A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

SEPTEMBER, 1936.

GENERAL PHYSICS.

ADSORPTION.

3912. Statistical Theory of Adsorption with Interaction between the Adsorbed Atoms. R. Peierls. *Cambridge Phil. Soc., Proc.* 32. *pp.* 471–476, *July*, 1936.—The statistical problem involved in Fowler's treatment of the adsorption isotherm for a monatomic gas [see Abstract 1387 (1936)] is solved by an approximation method due to Bethe [see Abstract 3259 (1935)]. N. M. B.

3913. Adsorption of Oils on Metallic Surfaces. J. J. Trillat and Renée Vaillé. *Comptes Rendus*, 202. *pp.* 2134–2136. *June* 29, 1936. —The interfacial tension at a series of oil-H_2O surfaces, the oil consisting of pure paraffin oil with addition of amounts of oleic acid varying from 10^{-5} to 1/500, was measured by a Nouy's tensimeter slightly modified so as to show any gradual change in the tension. In this way the change in tension at such a surface of such oils after being in contact for varying periods with steel balls was measured. The results indicate (and measure) a definite reduction in content of oleic acid due to its adsorption by the steel. C. A. S.

See also Abstract 3949.

ATOMIC AND MOLECULAR STRUCTURE.

3914. Exploring the Atomic Nucleus. S. Dushman. *Elect. Engineering*, 55. *pp.* 760–767 *and* 809, *July*, 1936.—A review of recent developments of investigations on nuclear structure, prepared at the request of the A.I.E.E. committee on education. AUTHOR.

3915. Series of Nuclear Levels. W. M. Elsasser. *J. de Physique et le Radium*, 7. *pp.* 312–314, *July*, 1936.—The spectrum of long range α-rays of RaC′ contains five intense groups whose energies are, to 1 %, in the ratio $\sqrt{3} : \sqrt{5} : \sqrt{7} : \sqrt{9} : \sqrt{11}$. A theoretical analysis shows that these numbers are proper values of an operator appearing in the Heisenberg-Majorana theory of exchange forces, and which represents the exchange interaction between a neutron and several protons, or *vice versa*. It is probable that a previously unknown type of nuclear activation is involved, characterised by a partial change in the interior of the nucleus of a neutron to a proton, or *vice versa*. The change may be regarded as a preliminary to nuclear transformation by β-emission. N. M. B.

3916. Approximate Solution of Nuclear Three and Four Particle Eigenvalue Problems. E. Feenberg and S. S. Share. *Phys. Rev.* 50. *pp.* 253–257, *Aug.* 1, 1936.—The problem of determining intranuclear forces from the mass defects of the H and He isotopes is investigated under the assumption that the interaction potentials are proportional to a function $f(ar^2)$ having the general form of a potential well and possessing the power series expansion $f(ar^2) = 1 - ar^2 + c_1(ar^2)^2/2! - c_2(ar^2)^3/3! + \ldots$ about the origin. With this assumption the Rayleigh-Schrödinger perturbation theory is applicable to the two, three and four particle eigenvalue problems. The perturbation calculation yields small corrections to the eigenvalues given by the "equivalent" two particle method. The corrections are checked very satisfactorily in a special case by means of a complicated variational calculation. Numerical results are given for two extreme forms of the neutron-proton model: Model I—Interaction between unlike particles only; Model II—Equal interactions between all pairs of particles. These results put close upper and lower bounds on the strength of the interaction between like particles in the model, intermediate between (I) and (II), which corresponds most closely to the experimental facts. AUTHORS.

***3917. Coincidence Experiments about the Neutron and γ-Ray Emission of Beryllium. H. Maier-Leibnitz.** *Zeits. f. Physik,* 101. 7–8. *pp.* 478–485, 1936.—A source of Po + Be surrounded by paraffin, formed the centre of a proportional counter which was operated by the recoil protons produced in the paraffin by neutrons. The counter was surrounded by 8 thick-walled counters for observing the γ-rays. Coincidences were looked for with a resolving power of 6×10^{-5} sec. The result is positive and proves that the γ-rays are emitted by ^{12}C. A similar experiment was carried out with two γ-ray counters, testing for the simultaneous emission of two γ-rays. The observed coincidences agree with the assumption that the two softer lines of 4·2 and 2·7 eMV are always emitted together and correspond to consecutive quantum jumps of one nucleus. R. P.

***3918. Artificial Radioactivity by an Electron Beam and Behaviour of Newly-Made Geiger-Müller Counters. W. B. Lewis and W. E. Burcham.** *Cambridge Phil. Soc., Proc.* 32. *pp.* 503–505, *July,* 1936.—An unsuccessful attempt was made to detect artificial radioactivity in Al after bombardment with electrons at 300 kV. During these experiments a transitory activity produced by cleaning the walls was observed in a Geiger counter. It is suggested that this might be due directly or indirectly to a progressive oxidation of the inner surface of the walls. AUTHORS.

3919. Artificial Radioactive Elements. M. E. Nahmias and R. J. Walen. *Comptes Rendus,* 203. *pp.* 71–73, *July* 6, 1936.—F (as LiF) and Na (metal) were bombarded with neutrons from Rn + Be (400 mc.). The periods of the products were, from F 8·4 (I) and 31 secs. (II) and from Na 8 (III) and 33 secs. (IV); the ratio of the intensities in air of I : II is 8, and of III : IV 0·3. I is attributed to $^{19}\text{F} + {}^{1}n \rightarrow {}^{20}\text{F}$, with some indication of a product of period 8·9 sec., perhaps due to $^{19}\text{F} + {}^{1}n \rightarrow {}^{16}\text{N} + {}^{4}\text{He}$. II is attributed to $^{19}\text{F} + {}^{1}n \rightarrow {}^{19}\text{O} + {}^{1}\text{H}$; III to $^{23}\text{Na} + {}^{1}n \rightarrow {}^{20}\text{F} + {}^{4}\text{He}$, and IV to $^{23}\text{Na} + {}^{1}n \rightarrow {}^{23}\text{Ne} + {}^{1}\text{H}$. 53 elements were examined by Frisch's method [see Abstract 2826 (1934)] for products of periods 0·5 – 5 sec., but with negative results. Only Be gave a product of period 0·7 sec., perhaps due to $^{9}\text{Be} + {}^{1}n \rightarrow {}^{9}\text{Li} + {}^{1}\text{H}$. C. A. S.

3920. Artificial Radioactive Products of Short Period. M. E. Nahmias and R. J. Walen. *Comptes Rendus,* 203. *pp.* 176–177, *July* 15, 1936.—Application of Frisch's method to the reaction $^{7}\text{Li} + {}^{2}\text{H} \rightarrow {}^{8}\text{Li} + {}^{1}\text{H}$, in which ^{8}Li should have a period of 0·5 or 0·7 sec. [see Abstract 1399 (1936)], gave no clear result. The reaction $^{11}\text{B} + {}^{2}\text{H} \rightarrow {}^{12}\text{B} + {}^{1}\text{H} \rightarrow {}^{12}\text{C} + e^{-} + {}^{1}\text{H}$ where the period of ^{12}B is reported to be 0·02 sec. was also examined preliminarily. [See also preceding Abstract.] C. A. S.

3921. Artificial Radioactivity Produced in Magnesium by α-Particles. C. D. Ellis and W. J. Henderson. *Roy. Soc., Proc.* 156*A*. *pp.* 358–367, *Aug.* 17, 1936.—The artificial radioactivity produced when Mg is bombarded by α-particles is studied and separate effects arising from

each of the three isotopes are identified. By investigating the effects produced by α-particles of different energies, information is obtained about the resonance levels of the isotopes. The results are discussed in terms of the energies available for the different reactions. The probability of ejecting protons from Mg^{24}, Mg^{25}, and Mg^{26} is very approximately in the ratio of 500 : 30 : 1. The electrons from the radioactive body Al^{29} of period about 11 min. are found to be of higher average energy than those from Al^{28} despite the latter's shorter period. The conclusion is drawn that the transition $Al^{28} \rightarrow Si^{28}$ is a " permitted " one without change of spin, but that $Al^{29} \rightarrow Si^{29}$ is " non-permitted " and involves a change of spin.
AUTHORS.

3922. Ionic Emission of Alkali Metals from Glass Melts and Relative Abundance of Isotopes of Lithium, Potassium and Rubidium. H. Bondy and V. Vanicek. *Zeits. f. Physik,* 101. 3–4. *pp.* 186–192, 1936.—Based on many observations with a previously described mass-spectrometer, two principles have been suggested for the connection between the ionic emission from glass melts and the magnitude of the ionisation potentials of the emitted particles. From these conclusions, certain requirements follow for the preparation of glass melts from which the ions of given elements can be obtained in sufficient and constant amounts. The probable mechanism of emission has also been investigated. For the ratio of the Li-isotopes the approximate value of $^7Li : {}^6Li = 12 : 1$, and for the K-isotopes the much more exact value of $^{39}K : {}^{41}K = 14{\cdot}1 \pm 1$ have been obtained. For Rb, a disagreement occurs between the relative abundance values and is due to the different sources of the Rb and their contingent impurities. Finally disturbances are reported in the form of double maxima.
H. H. Ho.

3923. Velocity of Slow Neutrons. J. R. Dunning, G. B. Pegram, G. A. Mitchell, G. Fink, E. Segrè. *Accad. Lincei, Atti,* 23. *pp.* 340–342, *March* 1, 1936.—A mechanical velocity filter consisting of two pairs of wheels mounted 54 cm. apart is used to measure the velocity of group C neutrons obtained from a Rn-Be source immersed in paraffin wax. One wheel of each pair is fixed while the other can be rotated at any speed up to 6000 r.p.m. Each wheel is provided with a complementary Cd sector completely opaque to group C neutrons and the net effect is the opening or closing of an aperture as the speed is varied. The pairs of wheels are rotated in phase and as the speed is increased the transmission of neutrons passes through a minimum when the time taken for the neutrons to traverse the distance of 54 cm. just corresponds to the closing of the second effective aperture. The minimum, which occurs at 2500 r.p.m., corresponds to a mean velocity of $2{\cdot}2 \times 10^5$ cm./sec. and the results are consistent with a Maxwellian distribution of velocity among the group C neutrons.
F. C. C.

3924. Laws of Absorption of Slow Neutrons. F. Rasetti, E. Segrè, G. Fink, J. R. Dunning, G. B. Pegram. *Accad. Lincei, Atti,* 23. *pp.* 343–345, *March* 1, 1936.—Using a rotating steel disc 50 cm. dia., enclosed between two discs of duralumin, the absorption of group C neutrons is examined when the disc is rotated towards and away from the oncoming neutrons respectively. The edge of the disc is covered with Cd absorber and the peripheral velocity is about $1{\cdot}4 \times 10^4$ cm./sec. A difference in absorption of only 6·3 % is observed : this agrees well with the value deduced theoretically on the assumption that the probability of capture of the group C neutrons is independent of their velocity, that the mean velocity of the neutrons is about $2 \cdot 2 \times 10^5$ cm./sec. and that their velocity distribution is Maxwellian. With a Ag disc, however, the difference in absorption is less than 1 % indicating that the probability of capture is approximately inversely proportional to their velocity. Experiments on the absorption in B and other elements are in progress.

F. C. C.

3925. Absorption and Diffusion of Slow Neutrons. E. Amaldi and E. Fermi. *Ricerca Scientifica*, 7. *pp.* 454–503, *June*, 1936.—Summary of the present state of knowledge of the absorption and diffusion of slow neutrons under the following headings: (1) introduction, (2) measurements and their reduction, (3) selective absorption, (4) groups of slow neutrons, (5) systematic absorption measurements, (6) behaviour of slow neutrons, (7) diffusion of slow neutrons of one group, (8) mean free path of slow neutrons of thermal energy, (9) groups as a function of the distance of the source: distribution of energy, (10) passage of neutrons from one group to another, (11) behaviour of the groups in the vicinity of a paraffin wax enclosure, (12) extension of the bands of energy of the groups, (13) results and discussion. F. C. C.

3926. Resonance Absorption of Neutrons. C. Y. Chao and C. Y. Fu. *Tsing Hua Univ., Sci. Reports*, 3. *pp.* 451–455, *July*, 1936. *In English.*—The induced activity produced by photo-neutrons in Ag and I is measured with a Geiger-Müller counter. By surrounding the source successively with paraffin layers, the Ag-activity is found first to increase and then to decrease, and a maximum occurs at $2 \cdot 5$ cm. A similar variation is found in I, with the difference that the activity of I at zero thickness of paraffin is quite appreciable. The total width of the absorption band of Ag, here concerned, is roughly estimated to be 2×10^4 eV. AUTHORS.

3927. Slowing Down of Neutrons by Thin Layers of Paraffin. S. Nishikawa, S. Nakagawa and I. Sumoto. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 128–130, *June*, 1936. *In English.*—Fermi and Amaldi [see Abstract 2945 (1936)] observed that in the slow neutrons which activate elements there are several groups, A, B, C, D and I. An experiment is performed to find out whether the neutrons of the various groups have different velocities. It consists in interposing between a Rn-Be source of neutrons and a suitable detector, Ag or I, layers of paraffin of various thickness to slow down the neutrons. The experiment is carried out both with and without the use of absorbers and the β-activity induced in the detector is measured by a Geiger counter. It is found that there exist at least two groups besides group C which are more effective than C in the activation of iodine and further, that the I group of Fermi and Amaldi seems to be a mixture of a group markedly absorbed by iodine, and another group of higher energy which is not much absorbed. There is also present besides C another group which effectively activates Ag. The experiment results are illustrated by sets of curves for Ag and I detectors connecting detected activity and paraffin thickness.

J. E. K.

3928. Diffraction of Neutrons. H. v. Halban, Jr., and P. Preiswerk. *Comptes Rendus*, 203. *pp.* 73–75, *July* 6, 1936.—Experiments are described showing the angular distribution of slow neutrons without a diffuser to be independent of the temperature of the paraffin. With a diffuser (of Fe) distribution depends on their velocity. For slow neutrons the intensity diminishes for small, increases for large deviations. The effect though small is sufficient to demonstrate diffraction of the wave associated with neutrons. C. A. S.

3929. Secondary Radiation Due to Neutrons. C. Haenny. *Comptes Rendus,* 203. *pp.* 173–175, *July* 15, 1936.—The absorption in Pb of the radiation emitted by Au and Cd (as metals), Gd (Gd_2O_3), Hg (HgO) and Cl (NH_4Cl) when bombarded by slow neutrons from Rn + Be is shown by plotting the number of impulses produced by the radiation against the thickness of Pb traversed. The energies (in 10^6 eV) thus deduced are for Cl 6 ; Gd probably 7–8 ; Cd 10, with some indication of also a softer component, Hg 15 with probably also a softer and a harder component ; results with Au point to the presence of more than one isotope. [See also Abstract 4769 (1935).] C. A. S.

3930. Molecular Interactions and Chemical Affinity. P. Girard and P. Abadie. *Comptes Rendus,* 202. *pp.* 2054–2057, *June* 22, 1936.—The ratios of the times of relaxation of polar molecules (BuOH) in solution in various non-polar diluents (CCl_4, CS_4, C_6H_{14}, C_6H_6) to the times for the same in the pure liquid, and similar ratios for the BuOH in solution in polar diluents of small moment (Et_2O, C_4H_4S, C_4H_4O, $EtCO_2H$ and BuOAc) have been plotted against concentration of BuOH. The variations indicate the degree of interaction and chemical affinity between the constituents of the solutions. [See also Abstract 1436 (1936).] C. A. S.

3931. Structure of Benzene. Part I. Problem and Experimental Method. W. R. Angus, C. R. Bailey, C. K. Ingold and C. L. Wilson. *Chem. Soc., J. pp.* 912–915, *July,* 1936.—The structure of benzene has long been one of the foremost of the unsolved problems of organic chemistry, the fundamental difficulty being that of reconciling the transformations of the aromatic nucleus with its stability. Concerning the chemical transformations of the nucleus, Kekulé's expression is undoubtedly the best single representation, and Dewar's is a permissible addition if a dynamical system be postulated, but neither satisfactorily interprets the stability of the ring, nor do the saturated but highly strained alternatives ; further, no formula is valid which does not provide the ring with at least the approximate planarity demanded by the evidence of crystal analysis. Recent developments of the modern theory of mesomerism with respect to benzene are now discussed with references, and the following 5 difficulties are pointed out : (1) Pauling and Wheland's value of α does not agree with that (0·72 eV) calculated by Penny from the twisting frequency of ethylene. (2) The instability of *cyclo*butadiene and *cyclo*octatetraene. (3) Pauling and Wheland's scheme of energy levels for the excited states of the benzene molecule places only one such level in the near ultra-violet, whereas there are at least 2 electron terms in this region. (4) The small prominent frequency of about 161 $cm.^{-1}$. (5) Identical frequencies in the Raman and infra-red spectra. The spectroscopic selection rule states that no fundamental, overtone, or combination tone can appear both in the Raman and in the infra-red spectra of a molecule possessing a centre of symmetry. In the following papers of the series, the authors study the benzene problem by the method of long-wave spectroscopy, which includes the study, not only of infra-red and Raman spectra, but also of the vibrational structure of bands arising from electron transitions. The validity and utility of this experimental approach to the study of molecular configuration is discussed, and also the modifications which a symmetrical structure entails with respect to the interpretations of combination frequencies. The u.v. absorption spectrum has not been studied since it appeared to be of secondary interest. H. H. Ho.

3932. Structure of Benzene. Part II. Direct Introduction of Deuterium into Benzene and Physical Properties of Hexadeuterobenzene. C. K. Ingold, C. G. Raisin and C. L. Wilson. *Chem. Soc., J. pp.* 915–925, *July,* 1936.—The authors prepare their hexadeuterobenzene by the exchange reaction between benzene and sulphuric acid, and obtain material containing only 1 % of of pentadeuterobenzene ; full experimental details are given together with a review of previous work on the subject ; and a theoretical discussion of the mechanism of the exchange. The physical properties of hexadeuterobenzene are reported as follows : *m.p.* 6·8° (*i.e.,* 1·3° higher than that of benzene) ; *b.p.* 79·3° (*i.e.,* 0·8° lower than the *b.p.* of benzene) ; density, $d_{25^\circ}^{25^\circ}$ 0·9456 or $d_{4^\circ}^{25^\circ}$ 0·9429 (*cf.* $d_{25^\circ}^{25^\circ}$ 0·8760, $d_{4^\circ}^{25^\circ}$ 0·8735 for benzene) corrected for residual protium ; refractive index (measured differentially against that of benzene by using a Pulfrich refractometer with a divided cell), $n_{4^\circ}^{22^\circ}$ 1·49779 (for benzene, $n_{D}^{22^\circ}$ 1·49982) ; molecular refractions, $[R_L]_D^{22^\circ}$ $(C_6H_6) = 26{\cdot}290$ c.c. ; $[R_L]_D^{22^\circ}$ $(C_6D_6) = 26{\cdot}146$ c.c. An Appendix contains a *Discussion* by **C. R. Bailey** and **B. Topley** of the vapour pressure of benzene, and it furnishes both the general principles which apply to any normal example and a semi-quantitative treatment of the particular case of benzene where the isotropic modification having the greater molecular weight has also the greater vapour pressure. Experimentally, the vapour pressure of hexadeuterobenzene has been measured differentially against that of benzene over 0–80°. H. H. Ho.

3933. Structure of Benzene. Part III. Raman Spectra of Liquid Benzene and Liquid Hexadeuterobenzene. W. R. Angus, C. K. Ingold and A. H. Leckie. *Chem. Soc., J. pp.* 925–931, *July,* 1936. —All the Raman spectra are photographed under somewhat greater dispersion than is commonly employed, and photometric measurements are made both of the peak intensities and of the integrated intensities of the principal lines. The intensities for benzene and hexadeuterobenzene are correlated by photographing the scattering spectrum of an artificial mixture containing 50 mols. % of each, and the polarisations have been measured for all the lines where practicable. Full experimental details are given, together with 5 comprehensive data tables for the frequency displacements of the Raman lines, peak and integrated intensities, and depolarisation factors of the principal Raman lines of benzene and of hexadeuterobenzene. There is greater rotational spreading of the lines of benzene than of hexadeuterobenzene, and all the lines of the latter are perceptibly narrower on the microphotometer records than the corresponding lines of benzene, as would be expected from the difference between the moments of inertia of these molecules. H. H. Ho.

3934. Structure of Benzene. Part IV. Infra-Red Absorption Spectra of Benzene and Hexadeuterobenzene both as Vapour and as Liquid. C. R. Bailey, J. B. Hale, C. K. Ingold and J. W. Thompson. *Chem. Soc., J. pp.* 931–941, *July,* 1936.—The authors have investigated as precisely as possible the absorption spectrum not only of benzene but also of hexadeuterobenzene over a range larger than is necessary to include all of the active fundamentals, and, in each case, have made a detailed study of the forms of the principal band heads. In each case also, the same specimen of highly purified material has been used both in the form of vapour and as liquid. The spectra given by the liquids and by their vapours are markedly different and the authors emphasise that the liquid spectra, though most instructive when the spectra of the vapours are known, can be very misleading in the absence of that knowledge. The apparatus used was essentially the monochromator arrangement described by Bailey and Cassie [see Abstract 3805 (1931)] supplemented by a potassium bromide system in order to extend the range of the apparatus in the long-wave region of the spectrum. Another modification, which greatly facilitated the readings, was the introduction of a photoelectric relay into the galvanometer system. Complete lists of the wave-lengths, frequencies and intensities of the infra-red absorption maxima are given, together with maps of the spectra and a comparison review of previous work. H. H. Ho.

3935. Structure of Benzene. Part V. Fluorescent Spectra of Benzene and Hexadeuterobenzene Vapour. C. K. Ingold and C. L. Wilson. *Chem. Soc., J. pp.* 941–954, *July*, 1936.—Vibrations can record their frequencies in the infra-red absorption spectrum only if they involve a periodic variation in the dipole moment vector, and in the Raman spectrum only if they give rise to an oscillation of the polarisability tensor. In very symmetrical molecules, however, there are usually several normal vibrations which leave both the dipole moment and the polarisability invariant, and in consequence u.v. spectra have been studied since the modes of nuclear vibration which can gain or lose quanta during an electron transition are determined by the change of shape which the molecule undergoes as a result of the electron switch, and by the nature of any vibrations which may already have been present in the initial electronic state. A comprehensive theoretical discussion precedes the experimental data, to indicate why the fluorescence and resonance spectra were chosen as those electronic spectra which can most directly assist in the problem of elucidating the vibrations of the normal benzene molecule. The apparatus, comprehensively described, was designed for the dual function of photographing both the fluorescence and the resonance spectra of benzene and hexadeuterobenzene. Tables are given of the electron terms and vibration frequencies, and maps of the spectra are included. Both substances indicate three electron levels and two active vibrations. The circumstance that transitions from all three electronically excited states to the ground state excite the same vibration frequencies, shows that the three excited states share with the ground state exactly the same common symmetry properties. It is very probable therefore that the three excited states have the same symmetry amongst themselves. H. H. Ho.

3936. Structure of Benzene. Part VI. Resonance Emission Spectrum of Benzene and Hexadeuterobenzene. C. K. Ingold and C. L. Wilson. *Chem. Soc., J. pp.* 955–966, *July*, 1936.—The authors discuss at the outset what may be expected from the selection rules governing the excitation of vibrations in transitions from a vibrating state, and in particular the rule of Herzberg and Teller [see Abstract 3562 (1933)], that the total vibrational wave-functions of the initial and final states must have the same symmetry properties. Herzberg and Teller's theory in relation to resonance spectra is summarised as follows: Totally symmetrical vibrations, being unrestricted as to change of quantum number, should be excited with successive quantum numbers, and should give rise to bands progressing with a spacing equal to one quantum, that is, to the fundamental frequency of the vibration. Non-totally symmetrical non-degenerate vibrations, should give bands progressing with spacings equal to twice the fundamental vibration frequencies. If several such vibrations have identical symmetry, progressions may be expected with spacings equal to the sum of the fundamental frequencies of pairs of vibrations of like symmetry. If degenerate vibrations are present, there may be a possibility of spacings equal to the sum of the frequencies of a non-totally symmetrical non-degenerate vibration and a degenerate vibration. The appearance of the degenerate vibrations themselves will be subject to restrictions which cannot definitely be predetermined, although they will in general include the restrictions applying to non-totally symmetrical vibrations. A very full discussion of the experimental data of the resonance spectra excited by the mercury 2537 Å line is given in conjunction with the recent conclusions of Cuthbertson and Kistiakowsky [see Abstract 611 (1936)]. Three of the pairs of frequencies obtained, agree with fundamental frequencies which are observed either in infra-red spectra or Raman spectra, and, since the agreement extends over both benzene and hexadeuterobenzene, they may be regarded as established. H. H. Ho.

3937. Structure of Benzene. Part VII. Coincidental Frequencies in the Infra-Red and Raman Spectra of Benzene and Hexadeuterobenzene. W. R. Angus, C. R. Bailey, J. B. Hale, C. K. Ingold, A. H. Leckie, C. G. Raisin, J. W. Thompson, and C. L. Wilson. *Chem. Soc., J. pp.* 966–971, *July,* 1936.—In order to generalise the principle of mutual exclusion to cover overtones and combination tones it is necessary to consider the symmetry not of the vibrations but of their wave-functions; from this standpoint, vibrations with symmetric wave-functions are excluded from the infra-red spectrum and those with anti-symmetric wave-functions from the Raman effect. It holds, therefore, quite generally that in the presence of a centre of symmetry the same frequency cannot occur in both spectra. A list of references to the number of coincident frequencies is given and a comprehensive discussion of them follows. It is shown that even if the molecule possesses a centre of symmetry in the undeformed state, deformation by cohesive forces in the liquid substance may give rise to the following coincidences: (*a*) strong Raman frequencies may appear, perhaps strongly, in the liquid infra-red spectrum, but should be absent completely from the vapour spectrum; (*b*) strong infra-red vapour frequencies can appear, though only feebly, in the Raman spectrum; (*c*) frequencies which, according to the selection rules, are inactive in both the infra-red and the Raman spectrum may appear, perhaps strongly, in the liquid infra-red spectrum, feebly in the Raman spectrum, and not at all in the infra-red vapour spectrum. The conclusion drawn from the application of (*a*), (*b*) and (*c*) to the actual coincidences for benzene and hexadeuterobenzene is that there is nothing to convey any suggestion of the absence of a centre of symmetry from these molecules. H. H. Ho.

3938. Structure of Benzene. Part VIII. Assignment of Vibration Frequencies of Benzene and Hexadeuterobenzene. W. R. Angus, C. R. Bailey, J. B. Hale, C. K. Ingold, A. H. Leckie, C. G. Raisin, J. W. Thompson and C. L. Wilson. *Chem. Soc., J. pp.* 971–987, *July,* 1936.—This paper attempts to establish a benzene model from the spectral frequencies of benzene and its isotopic modifications, with the possibility of a centre of symmetry not excluded [see preceding Abstract]. In this connection, the requirements of the plane, regular, hexagonal model are considered, since this is the most symmetrical of all possible models; it is styled the D_{6h} model, a symbol representing its symmetry classification in the theory of point groups. The requirements of the Kekulé model

(D_{3h}) and of the trigonally puckered model (D_{3d}) are likewise investigated for comparison purposes. A comprehensive application of symmetry theory to the various vibration frequencies is then made and 10 tables of classification data are compiled, while illustrative diagrams are included of the various models. The investigation, so far as it has yet progressed, supports the D_{6h} model; this is indicated by the success with which it is able to explain the salient features of the spectra, and especially the isotope shifts (5 numerical relations). On the other hand, the D_{3h} (Kekulé) model uniformly fails to exhibit any of the distinctive spectroscopic features by which it might have revealed itself; most notable is the non-appearance of E_g^+ frequencies in the infra-red spectra of benzene and hexadeuterobenzene vapour. Nothing has been found especially indicative of the D_{3d} (puckered) model, the reality of which must, however, remain an open question pending the identification of certain further fundamental frequencies (E_u^+ and B_{2g}). H. H. Ho.

3939. Nature of the Hydrogen Bond. Part I. Association in Carboxylic Acids. R. H. Gillette and A. Sherman. *Am. Chem. Soc., J.* 58. *pp.* 1135–1139, *July*, 1936.—An historical review of the hydrogen bond is first given, following which comes a calculation of the energy of the carboxylic acid complex with the aid of wave mechanics to throw some light upon its nature, *i.e.*, to determine whether it is polar, homopolar or both. Considerations are restricted for the present to formic acid, partly because it is the simplest acid and partly because accurate experimental data for the substance are available. In order to calculate the energy of the dimer, the spacial configuration suggested by Latimer and Rodebush [*Am. Chem. Soc., J.* 42. *p.* 419, 1920], and verified experimentally by Pauling and Brockway, has been adopted; this structure places all the atoms in a plane with carboxyl groups opposite one another, all the electrons being considered as uniquely paired except those in the ring, and the problem is treated in the ordinary way as one of 8 electrons with spin degeneracy. It is concluded that the wave function for a hydrogen bond should include both polar and homopolar terms, and that both are important although their relative importance could not be quantitatively decided. Most simply, therefore, the hydrogen bond must be considered as consisting of at least the three states, $X^-H^+X^-$, $X - HX$ and $XH - X$. H. H. Ho.

3940. Electron Diffraction Study of Paraldehyde. D. C. Carpenter and L. O. Brockway. *Am. Chem. Soc., J.* 58. *pp.* 1270–1273, *July*, 1936.—Paraldehyde is studied by the electron diffraction method and found to consist of a staggered six-membered ring of alternate C and O atoms having a C–O distance of 1·43 ± 0·02 Å. The bond angles are all tetrahedral and the three methyl groups are placed symmetrically about the molecule in nearly the same plane as the ring (*i.e.*, as fixed by the tetrahedral angles) with the possibility that only one of the methyl groups may be elevated above the plane of the ring. The methyl C atoms are attached to the C atoms of the ring by bonds having a length of 1·54 ± 0·02 Å. AUTHORS.

3941. Normal Vibrations and Isotope Effect of Molecules of the Type X_2Y_N with an N-Fold Axis of Symmetry. H. Schimmel. *J. Chem. Phys.* 4. *pp.* 508–512, *Aug.*, 1936.—In the present study it is assumed that the Y atoms are at the corners of a regular polygon and the X atoms are symmetrically situated on the N-fold axis of symmetry. The frequencies are calculated in terms of the parameters of a general quadratic potential energy form, the masses, and geometrical constants of the figure. Frequency shifts due to isotopes are also calculated. AUTHOR.

3942. Atomic Dimensions from the Coefficients of Compressibility and Thermal Expansion. G. F. Djang. *J. Chem. Phys.* 4. *pp.* 530–534, *Aug.*, 1936.—Starting from the equation of state $p - K(V - V_0)/V_0 = RT/V - V_0$, the relation $\alpha_a/\beta = R/(V - V_0)$ is derived, where V_0 is identified with the actual volume occupied by one mole of atoms or molecules. Values of the radii of atoms for different elements are calculated from this relation and compared with the values obtained from crystal analysis. The possibility of using the relation $\alpha_a/\beta = R/(V - V_0)$ to estimate molecular dimensions in the liquid state is also referred to. AUTHOR.

See also Abstracts **3977, 3978, 3979, 3982, 3985, 4027, 4029, 4034, 4038, 4139, 4140, 4168, 4172, 4197, 4198, 4206, 4207, 4214, 4218, 4234, 4271, 4272, 4285, 4287, 4358.**

COLLOIDS.

3943. Preparation of Hydrosols of Copper Arsenate and Arsenite. B. G. Saprometov and S. P. Kamsolova. *Kolloid Zeits.* 76. *pp.* 46–54, *July,* 1936.—The previously described electrolytic method [see Abstract 28 (1935)] is employed to prepare stable hydrosols of copper arsenate with charges of both signs and of copper arsenite with negative charge. The most favourable conditions of preparation are established. The resistance of the sols with respect to electrolytes is investigated and the magnitude of the electrokinetic potential determined by means of electrophoresis experiments. Attention is directed to the possibility of using these sols for dealing with insect pests in agriculture. L. A. W.

3944. Nature of Cellulose-Ester Solutions. S. Glückmann. *Kolloid Zeits.* 76. *pp.* 84–95, *July,* 1936.—In this investigation, the viscosity and solubility of benzyl cellulose, and the various fractions of it which are precipitated from its solution in alcohol-benzene by excess of alcohol, are studied. It is established that the parts of the benzyl cellulose which are respectively soluble and insoluble in benzene cannot be distinguished in principle with respect to composition and properties; also that on dilution of the solution, the equilibrium is not instantaneous, but that the viscosity continues to change throughout a long period. In the various fractions, the degree of esterification shows no regular deviation from the average value. The temperature-dependence of the coagulation on addition of both alcohol and benzene to the solution has also been investigated, and a contraction-method has been worked out for the determination of the volume change of a cellulose-ester solution during the quantitative alteration of the content of the components; this method affords a representation of the adsorption and desorption of the components of the solvent by the cellulose-ester particles. The conclusion is drawn from the data, that the stabilities of the benzyl cellulose solutions are conditioned by the adsorption equilibrium. Increase of concentration of the poorly adsorbed components by the non-polar groups of the benzyl cellulose leads to partial desorption of benzene and to coagulation in consequence of the cohesion forces of the cellulose exceeding the attraction forces of the solvent. Increase of temperature has the opposite effect and inhibits coagulation. H. H. Ho.

3945. Synthesis of Hydrosols of Difficultly Soluble Salts by Electrolysis. Hydrosol of Iron Phosphate. B. G. Saprometov and E. I. Smoligina. *Kolloid Zeits.* 75. *pp.* 291–297, *June,* 1936.—The

applicability of the electrolytic method to synthesise $FePO_4$ sol is examined. The following optimum conditions are stated to be the best for sol formation: the current strength is not to be higher than 5 A; the concentration of the original solution of sodium phosphate is not to be higher than $1/800N$; the optimum temperature in the electrolytic cell is 80°; the electrolysis must not last longer than 20 minutes; SiO_2 gel connecting the anodic and kathodic parts of the vessel and stirring of the solution lead to an increase in stability of the prepared sol. It is also shown that the mode of preparation of the sol affects its degrees of dispersion and its stability as, *e.g.*, towards electrolytes. [See also Abstract 28 (1935).]
J. K.

3946. Coagulation of Prussian Blue Sols by Electrolytes. E. L. Lederer. *Kolloid Zeits.* 76. *pp.* 54–60, *July*, 1936.—An account is given of investigations of the coagulation of Prussian blue sols (concentrations from 1·5 to 10 gm./l.) by means of salts of different valency types. It is found that the activity coefficient law of Ostwald [see Abstract 945 (1936)] is valid to a first approximation. The sols obey the Burton rule, for which an empirical formula is set up. The effect of duration of coagulation is also expressed by an empirical formula.
L. A. W.

3947. Electrolytic Coagulation of Weak Solvated Sols and Electrolytic Activity. Wo. Ostwald. *Kolloid Zeits.* 75. *pp.* 297–317, *June*, 1936.—The present paper deals with flocculation by neutral electrolytes and it is shown that a sol has four flocculation values for a given flocculating salt: m_{k0} the "dialysed" flocculation value, m_{k1} the usual flocculation value of (negative) sols, m_{k3} the usual flocculation value of discharged (positive) sols, and m_{k2} the "lower" flocculation value of discharged sols, which corresponds in character to the "dialysed" flocculation value of the original sol. These four experimentally determined flocculation values are related to the four flocculation activity coefficients: $f_{k0}^{+}, f_{k1}^{+}, f_{k2}^{-}, f_{k3}^{-}$. [See also Abstract 945 (1936).]
J. K.

3948. Velocity of Electrophoresis and Electrical Conductivity of Hydrophobe Colloids. A. J. Rutgers and J. T. G. Overbeek. *Zeits. f. phys. Chem.* 177. *Abt.A.* 1. *pp.* 29–39, 1936.—In this theoretical paper the authors give a solution of the paradox that for many sols the particle charge calculated from the velocity of electrophoresis is several orders of magnitude smaller than the charge deduced from conductivity measurements. The central particle is regarded as surrounded by an adhering layer of water (Smoluchowski layer). The opposing ions in the layer are supposed to be able to move freely relative to the water of the layer, while the remainder of the opposing ions are outside the layer in the free water. The velocity of electrophoresis is calculated for this new model, following the lines of the Debye-Hückel treatment. The electrical conductivity is also computed. It is found that all the opposing ions, whether in the Smoluchowski layer or not, contribute to the conductivity with the full mobility; but that only those outside the layer determine the velocity of electrophoresis. Finally, the relaxation effect and the influence of the different electrophoretic effects in the ionic atmosphere upon the conductivity are considered.
L. A. W.

3949. Viscosity of and Adsorption by Amyloid Sols. I. H. C. Merckel. *Kolloid Zeits.* 75. *pp.* 318–322, *June*, 1936.—The effect of sodium salts of monobasic acids on the viscosity of amyloid sols is examined. The viscosity values obtained are considered from the point of view of lyotropic numbers. Kruyt's theory is discussed in order to explain the viscosity of amyloid sols under the influence of electrolytes. It follows from Kruyt's theory that the above-mentioned salts are adsorbed by amyloid sols. These adsorption values with reference to the lyotropic series form a cubic function. Similar researches carried out with different alkali chlorides show a linear relationship between adsorption and the lyotropic series. J. K.

3950. Relation between Low-Temperature Research and Colloid Chemistry. F. F. Nord. *Naturwiss.* 24. *pp.* 481–486, *July* 31, 1936.—The preservation of fruit, vegetables and fish by means of cold storage is here considered from the point of view of colloid chemistry. The paper is a review of literature on the properties of various colloid substances said to be analogous to the constituents of the above foods. The cooling of colloidal solutions is considered at some length, and by analogy with the ice-water eutectic mixture the effect of the rate of cooling is deduced. The part played by fermentation is mentioned, and the influence of cold and freezing on such properties as surface tension, viscosity, conductivity, dielectric constant, etc., is discussed. Curves are given showing the effect of temperature on the surface tension-concentration relation, for solutions of egg albumen in sodium oleate. A fairly comprehensive Bibliography is appended. E. H. D.

3951. Liesegang Periodicity and Concentration of Reacting Drop. Suzanne Veil. *Comptes Rendus,* 202. *pp.* 2078–2079, *June* 22, 1936.—If the distribution constant of a system of Liesegang rings is defined as $\mu = \sqrt{d_n} - \sqrt{d_{n-1}}$ where d_n is the distance between the nth and the $(n - 1)$th rings, and μ is plotted against the concentration, c, of solutions of $AgNO_3$, drops of which form the rings on gelatin impregnated with bichromate, a straight line is obtained, which indicates the relation $\mu = A/c + B$, where A and B are constants. [See also Abstract 4393 (1934).] C. A. S.

3952. Natural and Mechanical Variations and Distortion of Vegetable Fibres. L. Belenkyi and A. Bojarkin. *Techn. Phys., U.S.S.R.* 3. 5. *pp.* 441–464, 1936. *In German.*—An investigation of the factors by which the X-ray diagrams of fibres can be influenced or alternatively are influenced in ordinary practice. After a discussion of the various means of deformation and the effect upon the fibre as determined by polarised light, microscopy, etc., the details of the X-ray method are given. The ordinary iodine values, etc., are taken and then the fibres are radiated with monochromatic X-rays from a Cu anode. Mechanical disturbance of ramie and flax fibres expresses itself in the typical fibre diagram by showing well-defined lamina lines. In intermediate positions enhancement of the contrast and the intensity of interference as also the occurrence of doublets is observed. The mechanical treatment of cotton, *e.g.*, calendering, finds no effect whatever on the X-ray picture. The interference lines of mercerised cellulose which are observed in the X-ray diagram of satin, disappear when coloured with aniline black. This phenomenon is both theoretically and practically interesting and is the subject of a further investigation. A method is devised for the determination of the inclination of the elementary cells of the fibre structure to the fibre axis and their response to mechanical treatment. In bast fibres mechanical action results in a considerable increase in the marks along their length but in cotton no alteration occurs whatever. The curves of orientation of both ordinary and distorted fibres are determined by a photometric method and these curves characterise the degree of orientation. The dimensions of the micelles vary little with mechanical distortion of the fibre, the actual values obtained being a little less than those of Henstenberg and Mark. When a cotton micelle is measured as in observation of satin, the micelle dimensions are greater, but again when coloured with aniline black the size is decreased. Chemical influences are thus illustrated. Tables of X-ray results are collected and compared as also of other constants of the fibres, orientation, etc. One table is of interest showing the effects of mechanical treatment, calendering, etc., on the X-ray properties of flax. S. G. B.

*3953. **Collodion Membranes. V. Nowatke.** *Kolloid Zeits.* 75. *pp.* 269–284, *June*, 1936.—This paper is concerned with the preparation and physical properties of uniform collodion membranes. Their three characteristic constants, namely, thickness, water content, and water permeability are measured in a Florence apparatus. Thinner, more elastic and stronger membranes are obtained from solutions of collodion-cotton of higher viscosity. The permeability grows less with decrease in viscosity. A 1 % decrease of nitrogen content of collodion cotton leads only to a definite increase of water-permeability of the corresponding membranes. Membranes of maximum permeability can be obtained from any solution of collodion-cotton if a definite quantity of air is passed through the cylinder, in order to remove solvent. Increase in permeability is obtained by the addition of the following substances to the collodion-cotton solutions : *n*-butyl alcohol < isobutyl alcohol < propyl alcohol < ethyl alcohol < methyl alcohol < ethyl urethane < acetone < glycerin < water. The following additions lower the permeability : glacial acetic acid < amyl alcohol < ethyl ether < acetophenone < caprionic acid < *n*-butyl aldehyde < phenol < acetoldehyde < ethyl acetate < benzol < butyl acetate < amyl acetate < oleic acid < castor oil. An increase in permeability of the membranes as well as of strength and of smoothness of surface can only be obtained indirectly by the addition of definite quantity of substances. Dialysis data for alkali chlorides and urea obtained with a specially constructed dialysor are given and examined. J. K.

3954. X-Ray Studies of Protein Structure. W. T. Astbury. *Nature,* 137. *pp.* 803–805, *May* 16, 1936.—A summary of the subject. Proteins would appear to be essentially polypeptides formed by repeated condensation of α-amino acids. X-ray methods applied to fibroin have shown that for natural silk at least the above hypothesis is correct. X-ray photographs of all natural protein fibres, etc., show certain features in common with natural silk and it would seem that they are all built from chain molecules lying along or simply related to the fibre axis. The results of stretching hair and photographs indicate that the chain molecules of keratin are normally in some regularly folded state from which they may be pulled straight. This fact leads to an explanation of their elasticity. The differences and transition from the α to the β keratin are described and the keratin base for all proteins is indicated. The dimensional factors concerned with the structural arrangement are given and discussed. S. G. B.

*3955. **Disperse Systems in Gases: Dust, Smoke and Fog.** *Faraday Soc., Trans.* 32. *pp.* 1041–1297, *Aug.*, 1936.—A general survey arranged under two main headings, preceded by an Introductory Address, and followed by a General Discussion, as follows :—

Introductory Address. " Disperse Systems in Gases," by **R. Whytlaw-Gray** (*pp.* 1042–1047).—Review of the problems arising with smoke, coagulation, dusts, and the position of the theory of Smoluchowski.

Part I (a). Solid and Liquid Non-Volatile Particles, i.e., Smoke, Dust, Oil Fogs, etc. (14 papers.)

"Properties of Aerocolloid Systems, with regard to Dependence on Methods of Formation," by **K. E. Stumpf and G. Lander** (*pp.* 1048–1055).—Aerosol behaviour affected by chemical and physical conditions during preparation : importance of form and size of particles.

"Sedimentation Method of Finding the Number of Particles in Smokes," by **R. Whytlaw-Gray, W. Cawood and H. S. Patterson** (*pp.* 1055–1059).—Known volume of smoke in a chamber of known dimensions permits counting when the deposit on the lower plate of the chamber is suitably illuminated.

"Influence of Pressure on Coagulation of Ferric Oxide Smokes," by **W. Cawood and R. Whytlaw-Gray** (*pp.* 1059–1065).—A study of ferric oxide aerosols, prepared from iron carbonyl. The particulate volume graphs are linear, steepening, however, with falling pressure.

"Movement of Dust or Smoke Particles in a Temperature Gradient," by **W. Cawood** (*pp.* 1068–1073).—The observed effects are of the correct order of magnitude and explain the behaviour of particles in moving away from a hot body.

"Dust-Free Space Surrounding Hot Bodies," by **H. H. Watson** (*pp.* 1073–1081).—At atmospheric pressure, the thickness A of the dust-free space is a function of θ (temperature excess of hot body over ambient air), together with H, the convective loss, giving $A = L\theta H^{-0.38}$, where L is a constant. The various suggestions for the effect are reviewed. Differential molecular bombardment seems likely.

"Determination of Size Distribution in Smokes," by **H. S. Patterson and W. Cawood** (*pp.* 1084–1088).—(1) Photometric method, (2) Graticule method. Possible extension to work on size distribution in gases.

"Cohesion between Smoke Particles," by **R. S. Bradley** (*pp.* 1088–1090).—Theoretical considerations concerning surface energy, temperature, particle size, etc., in their relation to cohesion in solids.

"Size-Frequency of Particles in Mineral Dusts," by **H. L. Green** (*pp.* 1091–1098).—Deals with the sampling of mineral dusts with the thermal precipitator. Most of the particles are smaller than 2μ dia., and are considered to be disintegration aerosols of high dispersion.

"Aggregation of Suspended Particles in Gases by Sonic and Supersonic Waves," by **O. Brandt and E. Hiedemann** (*pp.* 1101–1110).—Study of rapid coagulation by sonic and supersonic waves of frequency between 5 and 50 kc. Particles increase greatly in size under the influence of the field : flowing aerosols may be coagulated and precipitated in intense fields.

"Coagulation of Smoke by Supersonic Vibrations," by **E. N. da C. Andrade** (*pp.* 1111–1115).—A relation is obtained between time and the number of particles (considering the process as continuous). Experiments verify the general correctness of the theory.

"Experiments on Coagulation by Supersonic Vibrations," by **R. C. Parker** (*pp.* 1115–1119).—Observations with magnesium oxide smoke.

"Measurement of the Optical Densities of Smoke Stains on Filter Papers," by **A. S. G. Hill** (*pp.* 1125–1131).—Use of a photoelectric density meter. Known volumes of aerosols are drawn through restricted areas of filter-paper. Applications to air filters.

"Rate of Charging of Droplets by an Ionic Current," by **N. Fuchs, I. Petrajanoff and B. Rotzeig** (*pp.* 1131–1138).—Electrical method for oil-droplets of radius $0 \cdot 5\mu$ to 3μ.

"Exact Theory of Coagulation of Spherical Particles Arising from Thermal Agitation," by **W. R. Harper** (*pp.* 1139–1144).—Smoluchowski's theory of homogeneity stands, but only applicable to spherical particles; otherwise marked change in coagulation coefficient.

Part I (b). Aqueous and Other Volatile Particles, i.e., Mist, Cloud, Hygroscopic Nuclei, Town and Country Fogs. (11 papers.)

"Introductory Paper," by **G. M. B. Dobson** (*pp.* 1149–1152).—General questions such as the cutting out of sunlight and daylight, effect of different wave-lengths, importance of effects in large cities and in suburbs.

"Nucleus in and Growth of Hygroscopic Droplets," by **H. Köhler** (*pp.* 1152–1161).—Size of droplets in clouds changes, and sizes other than those giving maximum frequency are found.

"Nature of Dispersoids in Country and Town Air," by **J. H. Coste** (*pp.* 1162–1171).—Some dispersoids are living cells. Town air contains droplets from gaseous combustion products: fine silicious matter sometimes found both in town and country. Low concentration.

"Determination of Mass and Size of Atmospheric Condensation Nuclei," by **J. J. Nolan and V. H. Guerrini** (*pp.* 1175–1179).—Calculations of velocity of fall, coefficient of diffusion, mass, size. Effect of time; observations on nuclei in country air.

"Hygroscopic Nuclei in Formation of Fog," by **J. C. Philip** (*pp.* 1182–1184).—Evidence of primary event in fog formation, and the problem of deliquescence.

"Sorption of Fogs by Liquids," by **H. Remy** (*pp.* 1185–1190).—Concentration and liquid layer, sorption by acid and alkali, streaming velocity and coefficients.

"Fog along the Meuse Valley," by **J. Firket** (*pp.* 1192–1196).—An account (medical, meteorological and chemical) of the disastrous fog of December, 1930.

"Sulphuric Acid as a Disperse Phase in Town Air," by **J. H. Coste and G. B. Courtier** (*pp.* 1198–1201).—Determination without the use of filters.

"Influence of Urban Conditions on the Circulation of Electricity through the Atmosphere," by **F. J. W. Whipple** (*pp.* 1203–1209).—Review of the difficulties encountered in the interpretation of potential gradients.

"Sulphuric Acid Mist," by **A. Dooley and C. F. Goodeve** (*pp.* 1209–1218).—Support for the explanation of non-absorption of SO_3 in water, but its absorption in concentrated H_2SO_4. Importance of initial hydrogen sulphate nucleus.

"Removal of Mist by Centrifugal Methods," by **C. F. Goodeve** (*pp.* 1218–1221).—Impinging gas stream methods, filters, removal by falling drops.

Part II. Industrial Aspects of Disperse Systems in Air and Gases. (9 papers.)

"Introductory Paper," by **R. Lessing** (*pp.* 1223–1232).—Review of the following aspects—dust, smoke, fog, flue gases, mining dust, cleaning gases, considered from technical and industrial aspects.

" Twenty-five Years' Progress in Smoke Abatement," by **J. S. Owens** (*pp.* 1234–1241).—An account of the work of the Atmospheric Pollution Committee.

" Inflammation of Dust Clouds," by **R. V. Wheeler** (*pp.* 1244–1249).—Effect of concentration and fineness upon inflammability. Graphs for the behaviour of coal-dust and methane in air.

" Spread of Smoke and Gases from Chimneys," by **C. H. Bosanquet and J. L. Pearson** (*pp.* 1249–1263).—The problem attacked by dimensional analysis, results agreeing fairly well with observation. At distances of 10 times the chimney height the concentration at ground level is a maximum. At great distances the chimney height is immaterial.

" Dissipation of Fog," by **D. Brunt** (*pp.* 1264–1268).—Discussion of two methods, thermal, and chemical.

" Variations in Atmospheric Dust Content due to Micro-Atmospheric Influences," by **R. Meldau** (*pp.* 1270–1272).—" Contours " of dust distributions in Halle, Leipzig and Berlin.

" Energy Efficiency of Ionisation in Electrical Precipitation," by **C. A. Meek and R. W. Lunt** (*pp.* 1273–1284).—Calculation of overall energy efficiency, based on Prinz's theory, gives results far below the maximum value. Importance of corona size and corona field.

" Physical Basis of Electrical Gas Purification," by **G. Mierdel and R. Seeliger** (*pp.* 1284–1289).—Discussion of (1) charging of dust particles in the corona discharge, (2) drift and precipitation, (3) and influence of dust on electrical conditions.

" Commercial Plant for Removal of Smoke and Oxides of Sulphur from Flue Gases," by **G. Nonhebel** (*pp.* 1291–1296).—Full physical and chemical details of the Swansea Power Station.

F. I. G. R.

See also Abstracts **4126**, **4175**.

CRYSTAL STRUCTURE AND PROPERTIES.

3956. Distortion of Ions in Binary Crystals. T. Neugebauer. *Zeits. f. Krist.* 94. *pp.* 349–357, *Aug.*, 1936.—The author develops, on the basis of quantum mechanics, expressions for the distortion of the electronic field of an ion caused by a neighbouring point charge. These expressions are then applied to binary crystals having various lattice types.

J. I.

3957. Lattice Constants of Very Pure Aluminum. A. Ievinš and M. Straumanis. *Zeits. f. phys. Chem.* 33. *Abt.B.* 4. *pp.* 265–274, 1936.—Value found—4·04146 ± 0·003 Å (for 25° and 57·4 mm. camera). Also minutely different figures for other temperatures and cameras for which corrections are made. The metal was 99·9986 % pure. F. I. G. R.

3958. Thermal Expansion of Crystal Lattices of Cadmium, Osmium and Ruthenium. E. A. Owen and E. W. Roberts. *Phil. Mag.* 22. *pp.* 290–304, *Aug.*, 1936.—The structures of these metals were observed between 20° and 280° (for Cd) or 600° C. *in vacuo* in a high-temperature X-ray camera. The base side of the hexagonal close-packed structure of Cd follows a formula $a(20^\circ + t) = a(20^\circ) \cdot (1 + \alpha t + \beta t^2 + \gamma t^3)$, where α, β, γ are $21 \cdot 7 \times 10^{-6}$, -3×10^{-9} and 13×10^{-12} respectively. The height of the cell follows a similar formula with the coefficients $55 \cdot 8 \times 10^{-6}$, -15×10^{-9} and -4×10^{-12}. The mean thermal expansion coefficient between 0° and 100° C. of Os is $5 \cdot 9 \times 10^{-6}$ parallel and $4 \cdot 0 \times 10^{-6}$ perpendicular to the hexagonal axis. For Ru the corresponding figures are 8·8 and 5·9.

Values for higher temperatures are also given. Crystals of sublimated Cd were found to have their hexagonal axis parallel to the direction of the vapour stream. R. P.

3959. Structure of the Intermetallic Phases MgAu and MgHg. G. Brauer and W. Haucke. *Zeits. f. phys. Chem.* 33. *Abt.B.* 4. *pp.* 304–310, 1936.—Alloys MgAu (I) and MgHg (II) containing respectively 48·7 and 50·8 (atomic) % Mg, prepared in an atmosphere of A, are respectively white and yellowish. I is stable in air, but II quickly blackens therein, and is decomposed by water. The densities are (I) 10·72 and (II) 8·96. Both have CsCl lattices with a = (I) 3·259 and (II) 3·442 Å, and 2 atoms (one of each metal) in the unit cell. Compared with the totals of the atomic radii the least distances between the atoms are Mg – Au = 2·82 and Mg – Hg = 2·98 Å, indicating contractions of 4·5 and 2·3 % respectively. The Hume-Rothery law is not obeyed, the electron-atom ratio being 2 : 2 instead of 3 : 2. C. A. S.

3960. Polymorphic Transformations in Simple Ionic Lattices. Part II. NaCl → CsCl-Lattice. G. Wagner and L. Lippert. *Zeits. f. phys. Chem.* 33. *Abt.B.* 4. *pp.* 297–303, 1936.—Vaporised RbCl was condensed at the temperature of liquid air on a layer of TlCl already at that temperature. It was thus obtained as α-RbCl with CsCl-lattice, with $a = 3{\cdot}742$ and density 3·807. This α-form is only stable at this low temperature, reverting to the ordinary β-form (with NaCl-lattice) on warming. [For Part I see Abstract 966 (1936).] C. A. S.

3961. Structure of Plastically Deformed Crystals. Part II. A. Komar and M. Mochalov. *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 613–617, 1936. *In English.* Qualitative studies are made of the angular and spacial distribution of the rotated parts in single crystals of magnesium, plastically extended (10 %). [For Part I see Abstract 3427 (1936).]
AUTHORS.

3962. X-Ray Investigation of AlB_{12}. S. v. Náray-Szabó. *Zeits. f. Krist.* 94. *pp.* 367–374, *Aug.*, 1936.—The so-called "crystalline boron" contains two main kinds of crystals, graphite-like, and diamond-like. The former is known to be the compound AlB_{12}. The author shows by means of an X-ray study of the crystal structure of the diamond-like portion that it also is composed of AlB_{12}. The latter crystals are tetragonal (or orthorhombic pseudo-tetragonal) with $a = 12{\cdot}55$ Å and $c = 10{\cdot}18$ Å. There are 16 mol. of AlB_{12} per unit cell. It is suggested that the carbon content (0·7 %) of the diamond-like form is combined as the carbide B_4C and further, that owing to the similarity of the lattice dimensions of B_4C and AlB_{12} they are present in the diamond-like form as alternate layers. J. I.

3963. Structure of Gypsum, $CaSO_4{\cdot}2H_2O$. W. A. Wooster. *Zeits. f. Krist.* 94. *pp.* 375–396, *Aug.*, 1936. *In English.*—The structure of gypsum is investigated using ionisation spectrometer measurements of ($h0l$) and $0k0$) reflections. The structure so obtained is confirmed by oscillation photographs showing (hkl) planes. The structure is of the layer-lattice type and the layers of Ca and SO_4 ions are separated by planes of water molecules. The Ca is surrounded by six sulphate O atoms and two water molecules, the S is at the centre of an O tetrahedron and the water molecules have two O atoms and one Ca as their first neighbours. The angle between the water-oxygen bonds is 108°. The structure explains qualitatively the perfect, fibrous and imperfect cleavages, the anisotropy in the thermal expansion, the orientation of the optical indicatrix and the change of optic axial plane on raising the temperature. The structure proposed by E. Onorato [see Abstract 476 (1930) is shown to be based on the wrong space-group, to postulate unacceptable inter-ionic distances, and to fail to account for the anisotropy in some of the physical properties. A discussion is given of conclusions which may be drawn from the existence of a few planes of a particular type which are said to give weak X-ray reflections. AUTHORS.

3964. Structure of $3CdSO_4 \cdot 8H_2O$. H. Lipson. *Roy. Soc., Proc.* 156*A*. *pp*. 462–470, *Aug*. 17, 1936.—The structure of $3CdSO_4 \cdot 8H_2O$ is based on the unit cell: $a_0 = 9 \cdot 44$ Å, $b_0 = 11 \cdot 87$ Å, $c_0 = 16 \cdot 49$ Å, $\beta = 117° 16'$. The space group is $I2/a$ (C_{2h}^6) and there are four molecules of $3CdSO_4 \cdot 8H_2O$ in the unit cell. The 38 parameters which define the structure are given. A study of the environments of the various atoms suggests there are strong forces between the Cd atoms and the SO_4 groups, and that much weaker ones are involved in the contacts of the water molecules. Though the bonds of the water molecules are similar in distribution to those found in other hydrated crystals, they appear to be more distorted; it is thought that this is a consequence of the weakness of the bonds. AUTHOR.

3965. Examination of Cellulose by Electron Diffraction. G. Natta and M. Baccaredda. *Accad. Lincei, Atti.* 23. *pp*. 444–448, *March* 15, 1936.—Thin films of cellulose have been studied by the method of electron diffraction and the following results obtained: $a = 8 \cdot 25$ Å, $b = 10 \cdot 3$, $c = 8 \cdot 00$, $\beta = 82°$ compared with the X-ray results, $a = 8 \cdot 60$, $b = 10 \cdot 30$, $c = 8 \cdot 07$, $\beta = 82°$. The *b* axis is in the plane of the lamina. C. J. B. C.

3966. Crystallographic Study of Tartaric Acid Derivatives. J. Wyart and Yeu Ki-Heng. *Comptes Rendus*, 203. *pp*. 95–97, *July* 6, 1936.—The following data are given for the crystal structure of four derivatives of tartaric acid:—

	Tartramide ($CONH_2$–CHOH–CHOH–$CONH_2$)	Tartramic Acid, (CO_2H–CHOH–CHOH–$CONH_2$)	Methyl Tartrate, (CO_2CH_3–CHOH–CHOH–CO_2CH_3)	Potassium Borotartrate, ($[\{CO_2H$–CHOH–CHO–$CO_2\}_2B]K \cdot H_2O$)
System	Orthorhombic	Orthorhombic	Orthorhombic	Orthorhombic
a (Å)	10·0	12·30	18·50	4·88
b (Å)	12·2	7·96	10·00	18·00
c (Å)	4·90	6·00	8·45	7·65
Mol. per cell	4	4	8	2
Density (obs.)	1·625	—	1·492	1·794
Do. (calc.)	1·634	1·675	1·503	1·78
Space Group	V_1–P222	V_2–$P2_122$	V_2–$P222_1$	V_2–$P22_12$

The first three compounds show no molecular symmetry in the crystal, but the last compound, pot. borotartrate, possesses a 2-fold axis of symmetry. J. I.

3967. Structure of *p*-Azoxyphenetol. P. Chatelain. *Comptes Rendus,* 203. *pp.* 266–268, *July* 20, 1936.—The crystals are monoclinic with the following lattice parameters, $a = 15{\cdot}9$ Å, $b = 5{\cdot}42$ Å, $c = 17{\cdot}5$ Å, $\beta = 94° 20'$. They show positive birefringence with $\beta = b$ and γ inclined to (001) at 59°. The optic axial angle (2V) is 49·5° for the D line of sodium. The refractive indices for various wave-lengths are as follows :—

λ (cms. 10^{-5}) ...	6·50	5·89	5·46	4·92	4·36
α	1·510	1·517	1·521	1·529	1·542
β	1·575	1·584	1·587	1·599	1·617
γ	2·036	2·093	2·139	2·254	—

The crystals are strongly dichroic. [See also Abstract 1608 (1935).] J. I.

3968. Diffraction of X-Rays by Higher Polyethylene Glycols and by Polymerised Ethylene Oxides. W. H. Barnes and S. Ross. *Am. Chem. Soc., J.* 58. *pp.* 1129–1131, *July,* 1936.—X-ray powder photographs of the 54- and 162-membered polyethylene glycols are compared with those of the corresponding polymerised ethylene oxides (mol. wt. 3000 and 6500). A detailed examination is described of the 162-membered glycol and of the oxide of mol. wt. 3000. The results are compared with the measurements made by Sauter of some polymerised ethylene oxides [see Abstract 2713 (1933)]. The authors conclude that so far as the X-ray diffraction is concerned there is no essential difference between the polyethylene glycols and the polymerised ethylene oxides. J. I.

3969. Structure of Metaldehyde. L. Pauling and D. C. Carpenter. *Am. Chem. Soc., J.* 58, *pp.* 1274–1278, *July,* 1936.—The tetragonal crystal metaldehyde is shown by X-ray examination to have a body-centred unit of structure with $a_0 = 10{\cdot}40$ Å and $c_0 = 4{\cdot}11$ Å, containing two molecules of the tetramer $(CH_3\text{-}CHO)_4$. The atomic arrangement involves all atoms in general positions of the space group $C_4^5\text{–}I_4$, with the following parameter values : O, $x = 0{\cdot}074$, $y = 0{\cdot}140$, $z = -0{\cdot}163$; ring C, $x_1 = 0{\cdot}151$, $y_1 = 0{\cdot}047$, $z_1 = 0{\cdot}000$; methyl C, $x_2 = 0{\cdot}293$, $y_2 = 0{\cdot}090$, $z_2 = 0{\cdot}000$. The molecule contains an eight-membered –C–O–C– ring, with the C-O distance $1{\cdot}43 \pm 0{\cdot}03$ Å, and methyl groups attached to ring C atoms, with the C-C distance $1{\cdot}54 \pm 0{\cdot}03$ Å. The bond angles of O and C have the value $109{\cdot}5 \pm 3°$. A discussion of the packing of the molecules and of the packing radii of the methyl group and H atom is given. AUTHORS.

3970. Structure of Condensed Ring Compounds. Part IV. Fluorene and Fluorenone. J. Iball. *Zeits. f. Krist.* 94. *pp.* 397–409, *Aug.,* 1936. *In English.*—The crystal structure of fluorene and fluorenone is investigated by X-ray methods. In each case the crystals are orthorhombic, the unit cell of fluorene containing 4 molecules and that of fluorenone 16 molecules. It was found that the presence of impurities in crystals of each compound made no difference, within the limits of experimental error, to the unit cell dimensions or to the intensity of reflection. The intensities of reflection from the main planes of fluorene crystals are calculated and compared with those observed. As a result it is concluded that the fluorene molecule is not planar, but that the two aromatic rings are inclined to the plane of the middle five-membered ring. The structures derived from the X-ray results are shown to be in agreement with the optical and magnetic anisotropies. The structure of fluorenone bears a strong resemblance to that of fluorene. [For Part III see Abstract 1956 (1936).] AUTHOR.

***3971. Structure and Optical Characters of Nacre in Iridescent Shells. V. S. Rajagopalan.** *Indian Acad. Sci., Proc.* 3*A*. *pp*. 572–585, *June*, 1936.—Optical investigations by C. V. Raman and X-ray examination by S. R. Swamy have suggested certain results concerning the structure of the nacreous layers in iridescent shells. The problem is attacked in the present instance by studying thin sections of nacre with the aid of a petrological microscope. The sections are examined by plane polarised and convergent light and the results obtained correspond closely with those indicated by the other methods. J. T.

3972. Crystallisation of Supercooled Sulphur in the Electric Field. W. W. Kondoguri. *Phys. Zeits. d. Sowjetunion*, 9. 6. *pp*. 603–612, 1936. *In German*.—The crystallisation property of undercooled sulphur is determined as a function of the degree of supercooling. Application of an electrical field to the preparation is found to produce a displacement of the entire temperature curve. The appearance of a maximum on the curve is explained by a consideration of the viscosity. The influence of the electrical field on the crystallisation process is intelligible, when the combined effect of the field and of the glass surface of the preparation vessel is considered. The paper is illustrated with a microphotograph and several diagrams. H. H. Ho.

3973. Nature of "Excited" Colouring Centres. H. Wolff. *Phys. Zeits.* 37. *pp*. 552–554, *Aug*. 1, 1936.—Illumination with light within the absorption band of pure synthetic NaCl crystals reduces the maximum of the absorption band and extends the band towards longer wave-lengths. This process is known as "excitation." If the same process is repeated with crystals containing small amounts of $SrCl_2$ or $NaNO_3$ one obtains the same changes of the absorption band, but in addition the maximum is displaced towards longer wave-lengths. The maximum can be brought back to its original position by red illumination, it also comes back spontaneously because of the thermal motion. From these facts the conclusion is drawn that the "centres" responsible for absorption consist of regions of the crystal in which a strain is set up by the presence of foreign atoms. R. P.

3974. Electric Conductivity of Mechanically-Strained Single-Crystals of Rochelle Salt. F. Seidl. *Zeits. f. Physik*, 101. 3–4. *pp*. 234–254, 1936.—Mechanically strained single-crystals of Rochelle salt show an increase of electric conductivity. Measurements were made at temperatures of 22° to 24° C. For non-loaded crystals the anomalous charging currents in small time-intervals can be represented by the approximate formulæ of Kohlrausch. At 24° C. the smallest value found for the specific resistance of single-crystals was 10^{13} Ω cm., the greatest value being of the order of 10^{14} Ω cm. Crystals with cracks or flaws were found to have conductivities many powers of ten higher than single-crystals free from flaws. A. W.

3975. Micro-Plasticity in Crystals of Tin. B. Chalmers. *Roy. Soc., Proc.* 156*A*. *pp.* 427–443, *Aug.* 17, 1936.—Experiments are described on the isothermal stress-strain-time relations of single crystals of tin of two grades of purity (99·987 % and 99·996 %), the stress being pure tension and the strain being measured to 10^{-7} cm./cm. on a length of 3 cm. Creep is found to occur under all stresses; its initial rate being proportional to stress for small stresses, and of the order of 3×10^{-9} cm./cm./min. per gm./mm.^{2} (micro-creep), while above a fairly definite stress of the order of 120 gm./mm.^{2}, the rate of creep increases much more rapidly with stress (macro-creep). Micro-creep decreases with time in a roughly exponential manner, and macro-creep remains constant for a considerable time. The phenomena are considered from the point of view of the current theories concerning the mechanical strength of metallic crystals, and it is shown that micro-creep can be accounted for by an extension of G. I. Taylor's theory of fault propagation. AUTHOR.

3976. Efflorescence of Salts. K. Schultze. *Kolloid-Beihefte*, 44. 1–4. *pp.* 1–96, 1936.—This paper reviews the phenomenon of efflorescence from many aspects, *e.g.*, the behaviour of salts under natural and artificial conditions, and the blooming of sulphur from rubber compositions. 163 original papers are referred to, including the work of Wilhem Homberg, 1710. Ground efflorescence of the alkali salts and of the difficultly soluble substances such as chalk, gypsum, protective crusts, silicic acid are considered as well as the effects of climate, such as water, temperature, condensation and hygroscopy. The researches on the mechanism of efflorescence are reviewed, including the capillary theory of efflorescence. J. K.

See also Abstracts 3930, 3985, 4029, 4030, 4196, 4220, 4270, 4375, 4377.

DENSITY.

3977. Preparation of Light Water and Determination of Deuterium Concentration in Ordinary Water. N. Morita and T. Titani. *Chem. Soc. Japan, Bull.* 11. *pp.* 403–413, *June*, 1936. *In German.*—Light water with D/H ratio less than 1/200,000 was prepared by fractionally electrolysing Osaka tap-water, combining the deuterium-free hydrogen with atmospheric oxygen, electrolysing the water so formed and finally combining the hydrogen from this with oxygen also electrolysed from water. The light water had at 9·5° C. a density $18 \cdot 7 \pm 0 \cdot 5\gamma$/c.c. lower than that of the tap-water, implying a deuterium content in the latter of 1 : 5600, a value in agreement with the majority of published results. Since air-oxygen differs from water-oxygen in isotopic composition [see following two Abstracts] it is essential in this work that the light water is so prepared as to contain water-oxygen only. L. V. C.

3978. Difference in Isotopic Composition between Air- and Water-Oxygen; Electrolytic Separation Factor of Oxygen Isotopes. N. Morita and T. Titani. *Chem. Soc. Japan, Bull.* 11. *pp.* 414–418, *June*, 1936. *In German.*—Hydrogen from light water [see preceding Abstract and following Abstract] was combined with oxygen (*i*) from air, (*ii*) from partially (5 %), and (*iii*) from completely (95 %) electrolysed water. From (*i*) and (*iii*), air-oxygen was found 7 γ/*cc.* water heavier than water-oxygen, the same figure being obtained whether the hydrogen and oxygen were combined over a heated nickel catalyst or whether the gases were burnt together. From (*ii*) and (*iii*) a 2 γ/*cc. water* density-difference was found, attributed to an electrolytic separation factor of the oxygen isotopes, $\alpha(O^{16}/O^{18}) = 1{\cdot}01 \pm 0{\cdot}01$. L. V. C.

3979. Influence of Density-Difference between Air- and Water-Oxygen on Experimental Data Regarding Oxygen and Hydrogen Isotopes. N. Morita and T. Titani. *Chem. Soc. Japan, Bull.* 11. *pp.* 419–424, *June*, 1936. *In German.*—Examination of published data on the electrolytic separation-coefficient of oxygen isotopes gives as the most probable value $\alpha(O^{16}/O^{18}) = 1{\cdot}01$ [see preceding Abstracts] when allowance is made for the difference in isotopic composition of air- and water-oxygen. Allowance for this factor also explains published variations in the D/H ratio of hydrogen in mineral substances (*e.g.*, coal, hydrocarbons); the same is probably true also of other hydrogen-containing animal and vegetable products though superposed variations will result here from the (water-) oxygen content of these products. L. V. C.

***3980. Density and Coefficient of Expansion of Liquid Gallium. W. H. Hoather.** *Phys. Soc., Proc.* 48. *pp.* 699–707; *Disc.*, 707, *Sept.* 1, 1936. —Accurate measurements of the density and coefficient of expansion of liquid gallium at temperatures from 30° to 1000° C. are made by a dilatometric method. The temperature is measured with a platinum resistance thermometer. An equation expressing the increase in volume as a function of the temperature is found, and from that equation values are calculated for the coefficient of expansion. AUTHOR.

See also Abstracts **3932, 3966.**

DIFFUSION AND OSMOSIS.

3981. Passage of Helium through Glasses. (Lord) Rayleigh. *Roy. Soc., Proc.* 156*A*. *pp.* 350–357, *Aug.* 17, 1936.—He is known to pass through silica glass at the ordinary temperature. The transmission is of the order of 0·3 m^3./day/cm^2., using a plate 1 mm. thick. Air does not pass to any sensible extent. The process has been considered by Alty and others to consist in a creeping of the gas molecules along the walls of submicroscopic channels in the material. Ordinary glasses containing basic oxides do not transmit He. It is shown that boron trioxide glass possesses the property. He passes through it about as rapidly as through silica glass. Borax glass does not transmit He, so that the addition of a base stops the channels in this case as in silica. Various single crystals have been tested, including beryl, which is known from crystal analysis to have channels 2·6 Å wide, parallel to the axis. No passage of He was detected. The same applies to various light metals in the form of sheet, *viz.*, Mg, Al, Zn, Cu. Gelatin sheet transmits He much more freely than air (factor 184). The same applies in a less degree to celluloid and cellophane. The actual transmission of gelatin is greater than that of silica. An artificial channel, a few Ångströms wide, obtained by putting a plate on to the end of a glass tube in optical contact, shows something of the same behaviour. The ratio of transmission He/air found was 6·8 for the case examined. AUTHOR.

***3982. Separation of Gaseous Isotopes by Diffusion. D. E. Wooldridge and W. R. Smythe.** *Phys. Rev.* 50. *pp.* 233–237, *Aug.* 1, 1936.—The design and use of a 34-member apparatus of the Hertzian type for the separation of gaseous isotopes by diffusion are described. Results of tests of the speed of various types and numbers of separation members are given. Tests on mixtures of CO_2 and A at a pressure of a few mm. give the same results as tests on the Ne isotopes. The equilibrium time, from 10 to 15 hrs., and the separation factor, 80, of a 24-member apparatus, working on mixtures of such gases, are found to be independent of the initial mixing ratios. Results obtained with the 34-member apparatus on methane, to concentrate C^{13}, and on N_2, to concentrate N^{15}, are shown to be in reasonable agreement with appropriate theory. Methane containing 16 % of $C^{13}H_4{}^1$, and N_2 containing 6 % of $N^{14}N^{15}$, instead of the normal 1 % and 0·6 % respectively, have been produced. AUTHORS.

See also Abstract 4289.

ELASTICITY AND PLASTICITY.

3983. Restricted Elasticity. E. Volterra. *Accad. Lincei, Atti*, 23. *pp*. 329–332, *March* 1, 1936.—A further mathematical study is given of the deformations of elastic solids of which one dimension is preponderate, with axes either rectilinear or curvilinear, on the hypothesis of restricted elasticity. [See Abstract 2340 (1935).] J. J. S.

3984. Problem of Barré de Saint-Venant in a Homogeneous Medium Deformed from a State of Constraint. C. Platrier. *Comptes Rendus*, 203. *pp*. 36–38, *July* 6, 1936.—This entirely mathematical paper follows two previous communications [see Abstracts 3004 and 3447 (1936)] on generalisations from the problem of Saint-Venant, and investigates the deformation of a perfectly homogeneous and flexible bar which has already been subjected to constraint. Another generalisation has had to be derived respecting the imperfect flexibility of an elastic medium. H. H. Ho.

3985. Atomic Forces of Solid States. Part III. Weng Wen-Po. *Phil. Mag*. 22. *pp*. 281–286, *Aug*., 1936.—Parts I and II [see Abstract 3451 (1936)] concern the development of a function designated $f(r)$ to express interatomic forces in the solid state, and the present paper continues the discussion. A form of $f(r)$ is developed which has a similar form for all metals and simple polar compounds such as NaCl. The study of the nature of the function $f(r)$, however, is accompanied by a very unfavourable condition, for $f(r)$ represents a kind of force which originates from many ions instead of from a single ion. To overcome this difficulty the author deals with atomic repulsion alone, and assumes the force to be composed of both an attractive and a repulsive part, the latter being chiefly due to a combined effect of the outermost shell of electrons and the inner core. Lindemann's collision hypothesis of fusion has been found to be unsatisfactory, and an alternative fusion hypothesis is proposed which is more in accordance with the experimental data. H. H. Ho.

3986. Compressibility of Butane-Air Mixtures. F. W. Jessen and J. H. Lightfoot. *Indust. and Engin. Chem*. 28. *pp*. 870–871, *July*, 1936.—The compressibility of *n*-butane-air mixtures and of *n*-butane is determined at 30° C. It is shown that the additive rule for determining the compressibility of gas mixtures at low pressure does not hold for butane and air, the maximum deviation being 23 %. The variation of the compressibility coefficient of *n*-butane with temperature is presented. AUTHORS.

3987. Elastic Moduli of Definite Intermetallic Compounds. A. Portevin and L. Guillet, Jr. *Comptes Rendus*, 203. *pp*. 237–239, *July* 20, 1936.—The elastic moduli, determined by le Rollond and Sorin's pendulum method, of several such alloys divides them into two classes:

(*a*) where the modulus of the alloy is given approximately accurately (within 2–4 %) by the rule of mixtures, *e.g.*, CuZn, $SbAg_3$ and $MgZn_2$, and (*b*) where it considerably (20–40 %) exceeds the value so deduced, *e.g.*, $Cu_{34}Sn_8$, Cu_9Al_4, and $CuZn_4$. C. A. S.

3988. Rheological Properties of Asphaltic Bitumens. J. P. Pfeiffer and P. M. van Doormaal. *Inst. Petroleum Technologists, J.* 22. *pp.* 414–440, *June*, 1936. *Kolloid Zeits.* 76. *pp.* 95–111, *July*, 1936.—It is submitted that the working hypotheses evolved here give an idea of the constitution of asphaltic bitumens which makes it possible to understand the widely deviating rheological behaviour of the different types of these complicated hydrocarbon mixtures. The asphaltic bitumens are conceived as colloidal systems wherein the disperse phase, *i.e.*, the asphaltenes, consists of high-molecular hydrocarbons of a predominantly aromatic character with a comparatively low hydrogen content. It is stated that the peptisation of these asphaltenes is better if the dispersion medium is more aromatic or hydro-aromatic in character, that in bitumens produced from oils rich in aromatics or hydro-aromatics the asphaltenes may be peptised so well that their flow agrees with Poiseuille's law, that the degree of deviation in rheological behaviour from the purely viscous type can be expressed by the angle of incline of the penetration-temperature curve or in the " susceptibility to temperature change " of the bitumen, and that when judging of asphaltic bitumens for their suitability in practice it is important to classify them according to their " temperature susceptibility " expressed by an " index." as given by an index nomogram referred to in the paper. J. K.

***3989. Pendulum as a Source of Energy for Plasticity Measurements. I. Williams.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 304–306, *July* 15, 1936.—This paper deals with methods for the study of the consistency of rubber and commences by a description of various kinds of plastometer in use. An instrument is then described in detail in which a pendulum of known potential energy is used to produce a definite rapid deformation in a plastic material. The damping effect produced on the pendulum is a measure of the energy expended to produce the deformation. The elastic recovery, following the rapid deformation, is much greater than that obtained with the ordinary parallel-plate instrument. The actual measurement of the energy consumed and elastic recovery requires less than 1 min. Samples should be brought to a uniform temperature by preheating for at least 10 minutes at the temperature of the test. A photograph of this pendulum plastometer is included, and the type of results obtained is illustrated by the complete description of an experiment. The early stages of vulcanisation are detected with the pendulum plastometer by the rapid change in the elastic recovery. In many cases the elastic recovery will double before a noticeable difference is found in the energy consumed. H. H. Ho.

3990. Quasi-Harmonic Vibrations of a System with Quasi-Constant Elasticity. R. Einaudi. *Accad. Sci. Torino, Atti,* 71. 1. *Disp.* 2*a*. *pp.* 292–298, *Jan.–April*, 1936.—An equation is taken which represents a mechanical system having one degree of freedom and subjected to a restoring force which varies periodically with time. This equation is solved mathematically and examined to find the conditions under which an equilibrium configuration may be stable. The variations of the restoring force are small compared with its mean value. H. M. B.

3991. Formula of Response for a Forced Vibration by Harmonic Action. C. Jodi. *Accad. Lincei, Atti,* 23. *pp.* 421–426, *March* 15, 1936. —A mathematical consideration of the motion of a body which is displaced a distance x, varying from 0 to l, in time t. Equations are obtained and maximum and minimum displacements found in the case of a supported shaft, of constant inertia and mass. H. M. B.

3992. Vibrations of an Elastic System with Elastic and Inertial Coupling. A. Galli. *Accad. Lincei, Atti,* 23. *pp.* 572–580, *April* 19, 1936.—The frequency of vibration of a shaft, long compared with its width, is studied mathematically when it is in an elastic medium, which besides causing elastic changes has an inertial coupling. Partial differential equations, neglecting damping, are obtained and solved, and the results are applied to the specific case of a shaft of known length, elasticity, etc. H. M. B.

3993. Acoustic Studies of Special Steels. Mary D. Waller. *Roy. Soc., Proc.* 156*A*. *pp.* 383–393, *Aug.* 17, 1936.—An acoustic method used for determining the persistence of vibration and vibration frequency of transversely vibrating bars at different temperatures, is described. Some Hadfield special steels have been examined by the method between −183° C. and room-temperature. During the transformation from austenitic (γ) to martensitic, (α) Ni steel, the internal damping is greatly increased and Young's modulus of elasticity is considerably decreased. The modulus of α Ni steel is permanently less than that of Ni γ steel. Hadfield steel (12·69 % Mn, 1·27 % C.) has a maximum modulus at about − 50° C., which corresponds closely with a maximum found for carbon, and which is not present when the carbon content of this steel is low. AUTHOR.

3994. Development of Pressure Waves during the Longitudinal Impact of Bars. W. A. Prowse. *Phil. Mag.* 22. *pp.* 209–239, *Aug.*, 1936.—An attempt is made to determine how the geometrical shape of the impinging surfaces affects the longitudinal collision between metal rods, the ends of which have been ground to a spherical form. A method is described for measuring the duration of contact between silver steel rods $\frac{5}{8}$ in. in dia., of lengths varying from 63·6 to 8·5 cm. and with radii (of ball end) varying from 4·60 to 0·159 cm. In agreement with the results of Wagstaff, the relation between the time of contact t and the velocity of approach v is given by $t = Av^{\gamma}$ where A and γ are constants independent of v. This relation only holds for rods with hardened ball ends. The impact of very short bars is found to conform to the deductions of the Hertz theory, except that some modification is necessary to account for the change in the value of y. The relation $D = A'v^{\delta}$ is found between the diameter of the area of contact, D, and the velocity of approach, v, A′ and δ being constants independent of D and v. The process of collision is examined theoretically by considering impact between 2 bars of infinite length approaching each other with the same velocity; the development of pressure waves is discussed and the treatment is then extended to bars of finite length, for which the course of the pressure variations is given. An interpretation of impact phenomena observed experimentally is attempted in terms of a phase change and a coefficient of reflection. Finally, an approximate theory relating to impacts between soft ball ended bars is formulated. H. J. H. S.

***3995. Spring Formulæ and Precision Spring Scales. M. F. Sayre and A. V. de Forest.** *A.S.M.E., Trans.* 58. *pp.* 379–388, *July,* 1936.—The various errors in spring balances are studied and a new helical spring is designed, giving an error of less than 0·05 %. Variations due to changes in temperature are eliminated by the use of a special alloy of a modified elinvar type, containing 36 % Ni, 8 % or more Cr and 4 % of other elements, including Mn, Si, Mo, Cu and V, the rest being Fe. By suitable treatment the safe working stresses are raised to 60,000 lbs./in.^{2} and the error due to creep is reduced to less than 0·02 %. "Back error" or hysteresis is less than 0·04 %. The load-deflection curve deviates slightly from a straight line and accurate formulæ for this curve are developed in the paper. J. T.

GRAVITATION.

See Abstracts 4009, 4033.

HYDRODYNAMICS AND AERODYNAMICS.

3996. Mean Value of the Fluctuations in Pressure and Pressure Gradient in a Turbulent Fluid. G. I. Taylor. *Cambridge Phil. Soc., Proc.* 32. *pp.* 380–384, *July,* 1936.—(1) For the field of turbulent flow in which the turbulent velocity components, u, v, w are A cos ax sin by sin cz, B sin ax cos by sin cx, C sin ax sin by cos cz, with $\mathrm{A}a+\mathrm{B}b+\mathrm{C}c=0$ [and the mean velocity constant], the pressure is found by eliminating $\partial u/\partial t$, $\partial v/\partial t$, $\partial w/\partial t$ from the equations of motion and finding the periodic solution of the resulting equation. The r.m.s. pressure fluctuation is $\frac{1}{2}\mathrm{K}\rho$ times the average square of the resultant turbulent velocity, where K is given by a rather complicated formula in terms of A,B,C,a,b,c. For two-dimensional motion ($\mathrm{C} = 0$, $cz = \frac{1}{2}\pi$), $(\mathrm{A}^2 + \mathrm{B}^2)\mathrm{K} = 2\,\mathrm{A}^4 + 2\mathrm{B}^4)^{1/2}$, and K varies from 1 to $\sqrt{2}$. When $a = b = c$, which is the case nearest to isotropic turbulence, $\mathrm{K} = 1\cdot06$. From examples it appears that in the general case K lies between 1 and $\sqrt{2}$, but this has not been definitely proved. (2) For the same field of turbulent flow the lengths λ and λ_η and the constant B previously defined by the author [see Abstract 4101 (1935)] are calculated. λ, connected with the mean rate of dissipation per unit volume, $\overline{\mathrm{W}}$, by the formula $\overline{\mathrm{W}} = 15\,\mu\lambda^{-2}\overline{u^2}$ in isotropic turbulence, is here found from the formula $(\overline{\xi^2} + \overline{\eta^2} + \overline{\zeta^2})\,\lambda^2 = 5\,(\overline{u^2} + \overline{v^2} + \overline{w^2})$. For isotropic turbulence λ_η and B are connected with the r.m.s. pressure gradient by the formulæ $\sqrt{\overline{(\partial p/\partial y)^2}} = \sqrt{2}\,\rho\,\lambda_\eta^{-1}\,\overline{v^2} = 3\,\mathrm{B}\,\rho\{\overline{v^2}\,\overline{(\partial v/\partial y)^2}\}^{1/2}$, and $4\cdot5\ \mathrm{B}^2\,\lambda_\eta^2 = \lambda^2$, so that the constancy of B requires that λ/λ_η should be constant. Values derived from experiment were $\lambda = 2\cdot0\,\lambda_\eta$, $\mathrm{B} = 0\cdot94$. λ_η and B are here found from the formulæ $\lambda^2{}_\eta\,\Sigma\,\overline{(\partial p/\partial x)^2} = 2\rho^2\Sigma\,(\overline{u^2})^2$, $9\,\mathrm{B}^2\,\rho^2\Sigma\,\overline{u^2}\,\overline{(\partial u/\partial x)^2} = \Sigma\,\overline{(\partial p/\partial x)^2}$, (the summations being for cyclic permutations of x, y, z, and u, v, w). For $a = b = c$, $\lambda = 1\cdot44\,\lambda_\eta$, $\mathrm{B} = 0\cdot53$. S. G.

3997. Application of the Method of Images to Vortex Motion. G. Lampariello. *Accad. Lincei, Atti,* 23. *pp.* 426–431, *March* 15, 1936.—Using Lord Kelvin's method of images and considering a fixed sphere of centre O and radius R, the formation of vortices is obtained mathematically for a perfect fluid inside the sphere. The equation is applied to an infinitely thin vortex ring inside the sphere and the intensity and velocity of the vortices is determined. H. M. B.

3998. Velocity Distribution of Fluids in Pipes. E. C. Koo. *Chem. Eng. China, J.* 3. *pp.* 91–109, *June,* 1936. *In English.*—This paper continues previous work [see Abstract 2542 (1936)] and presents the result of a critical study on the velocity distribution of fluids flowing isothermally through circular pipes. The following modified form of the Prandtl-Kármán formula is suggested for velocity distribution in turbulent flow : $V/V_{\max} = (1 - r/R)^a$, where a is defined as the velocity distribution exponent which can be calculated from a general equation derived in this paper as, $a = -1\cdot5 + 0\cdot5\sqrt{9-8\,(\text{Re}\,df/fd\,\text{Re})}$, where Re = Reynolds number and f = friction factor in the Fanning equation. For technically smooth pipes a can be expressed as, $a = -1\cdot5 + 0\cdot5\sqrt{9 + 2\cdot56/(1 + 0\cdot0112\,\text{Re}^{0\cdot32})}$, and for commercial iron and steel pipes $a = -1\cdot5 + 0\cdot5\sqrt{9 + 3\cdot04/(1 + 0\cdot0163\,\text{Re}^{0\cdot38})}$. These velocity distribution exponent equations are based upon the new General Index Law equations on friction factor presented in the previous paper (*loc. cit.*). The velocity distribution exponent a is not a constant, but decreases as the Reynolds number increases. The ratio of average to axial velocity $= 2/(a+1)\,(a+2) = 1/1 - (\text{Re}\,df)/fd\,\text{Re}$. The simple method for calculating the average velocity of flow of fluids is recommended for obtaining one velocity measurement only at the axis of a pipe and making use of a plot of the velocity ratio against the maximum Reynolds number. Comprehensive literature references are included. H. H. Ho.

3999. Velocity Distribution in the Wake behind a Flat Plate Placed along the Stream. L. Rosenhead and J. H. Simpson. *Cambridge Phil. Soc., Proc.* 32. *pp.* 385–391, *July*, 1936.—If u_1 is the velocity parallel to the plate for the laminar two-dimensional flow of a viscous fluid in the wake behind a flat plate of length l at zero incidence, values of $u = u_1/U$, where U is the undisturbed stream velocity, have been calculated by Goldstein [see Abstract 5152 (1933)] : for $0 \leq x_1/l \leq 2\cdot8$ (x_1 = distance downstream from trailing edge) and tabulated for various values of x_1/l and $R^{\frac{1}{2}}y_1/l$ (y_1 = distance from the plane of the plate, $R = Ul/\nu$). Luckert [*Schriften des mathematischen Seminars und des Instituts fuer angewandte Mathematik der Universitaet Berlin* 1 (1934), p. 245], using v. Mises' form of the boundary layer equations, has tabulated $1 - u^2$ for values of x_1/l and ψ for $0 \leq x_1/l \leq 1\cdot0$, where ψ is the reduced stream function such that $R^{\frac{1}{2}}y_1/l$ is the integral of $u^{-1}d\psi$. Luckert's table has been transformed into one giving u for values of x_1/l and $R^{\frac{1}{2}}y_1/l$, and both sets of results retabulated for equal intervals of these variables. There is satisfactory agreement along the axis of the wake : for $x_1/l \geqq 0\cdot3$ there is a small systematic discrepancy, especially for the larger values of $R^{\frac{1}{2}}y_1/l$. (Luckert's results extend up to $R^{\frac{1}{2}}y_1/l = 3\cdot8$.) S. G.

4000. Boundary Layer Growth. S. Goldstein and L. Rosenhead. *Cambridge Phil. Soc., Proc.* 32. *pp.* 392–401, *July*, 1936.—For the two-dimensional motion of a viscous incompressible fluid, Blasius has calculated the second approximation to the velocity distribution in the boundary layer at the surface of a body started impulsively from rest, sufficient to give a first approximation to the time T that elapses before separation of the forward flow begins. For uniformly accelerated motion of the body, Blasius calculated the third approximation to the velocity distribution and the second approximation to T. In this paper, the third approximation to the velocity distribution and the second approximation to T are calculated for an impulsive start. If U is the velocity just outside the boundary layer, and dashes denote differentiation along the surface, then $T^{-1} = -0\cdot7122\,U' + (0\cdot7271\,U'^2 + 0\cdot05975\,UU'')^{\frac{1}{2}}$, and T has its least value when $-U'$ is greatest only if $U = 0$ there. For a circular cylinder of radius r, separation begins after the cylinder has travelled $0{\cdot}32r$ ($0{\cdot}35r$ for the first approximation. The values for uniformly accelerated motion are $0{\cdot}52r$ and $0{\cdot}585r$). The case of an elliptic cylinder with axes in the ratio 6 : 1 and at an incidence of 7^0 is considered. It appears that the term in UU'' in T^{-1} makes very little difference, and that separation begins not far from the point where $-U'$ is greatest; the second approximation for the distance traversed before separation begins is again about 9 % less than the first approximation for an impulsive start, and 11 % less for uniform acceleration. S. G.

4001. Boundary-Layer Flow over Flat and Concave Surfaces. A. H. Blaisdell. *A.S.M.E., Trans.* 58. *pp.* 343–348, *July,* 1936.—Experimental velocity distributions are given across the boundary layer at three distances from the leading edge for flow along a flat aluminium plate (with a bevelled leading edge) when the plate is parallel to the wind, and when it makes angles of 5° and 10° with the wind direction; and also for the concave side of a curved plate, for three different curvatures. Comparisons of the results among themselves, and with Blasius' theoretical solution for a flat plate at zero incidence, are given; but further interpretation is difficult in the absence of more data. S. G.

4002. Kinetic Energy of Laminar Flow through Rectangular Passages. J. Allen. *Phil. Mag.* 22. *pp.* 249–256, *Aug.,* 1936.—In the laminar motion of an incompressible viscous fluid through a pipe of rectangular cross-section the ratio of the true kinetic head to the apparent kinetic head based on the mean velocity in a cross-section is a function of the ratio of the width to the depth of the pipe. With a square section the ratio is 2·08 as compared with 54/35 or 1·5428 . . . for an infinitely wide passage. [See also Abstract 4044 (1934).] AUTHOR.

4003. Statistical Theory of Turbulence. Part V. G. I. Taylor. *Roy. Soc., Proc.* 156*A*. *pp.* 307–317, *Aug.* 17, 1936.—In this paper it is assumed that the disturbing effect of turbulence on boundary layers is due to the pressure gradients which accompany variations of pressure in turbulent flow. When the Reynolds number of turbulence is high the pressure gradient depends on the length λ which occurs in the theory of dissipation of energy in turbulent motion. The theory leads to the conclusion that the critical Reynolds number, R_{crit}, at which the drag coefficient of a sphere is 0·3 depends on $u'/U \times (D/L)^{1/5}$, where u'/U is the "percentage turbulence" and D/L is the ratio of the diameter of the sphere to the scale L of the turbulence. When the turbulence is due to a grid or honeycomb L is proportional to M, the mesh or cell diameter. The formula is shown to be in accordance with observations by Dryden in America and with some measurements made at Göttingen and at the Royal Aircraft Establishment. [For Parts I–IV see Abstract 4101 (1935).] AUTHOR.

4004. Flow of Water along Short Capillary Tubes Connecting Two Vessels with Free Surfaces. J. Allen. *Roy. Soc. Edinburgh, Proc.* 56. 1. *pp.* 26–37, 1935–1936.—The present investigation of the discharge of water from one vessel or reservoir to another with free surfaces through capillary tubes of various ratios of outside to inside diameters between 1·59 and 4·31 and of various l/d ratios between 28·8(7) and 155·2, indicates that the behaviour as a whole is represented by $2gh/v^2 = \alpha + \beta l/dR$, where $\alpha = 2{\cdot}60 - 15{\cdot}5\, d/l$, $\beta = 64{\cdot}00 + 1{\cdot}33 \times 10^6 (d/l)^{3\cdot44}$, provided the ends of the tubes are sharp and conditions within the selected range of values of R (200 to 2000). The losses of energy are reduced by grinding the ends to a bell-mouth shape, although the effect becomes very small with the longest tubes. AUTHOR.

***4005. Double Orifice Fluxmeters. G. Wälzholz.** *Forsch. IngWes.* 7. *pp.* 191–201, *July–Aug.*, 1936.—The discharge coefficients for fluxmeters depending on throttling devices depend on Reynolds number for low Reynolds numbers. The increase in the frictional loss with decreasing Reynolds numbers causes a decrease in the coefficient for a nozzle, but for a plate orifice is usually more than offset by the decrease in the contraction behind the orifice, so that orifice coefficients rise with decreasing Reynolds numbers. By using two constrictions, one behind the other (a double diaphragm or double plate orifice), it is possible to arrange that the two influences largely cancel out. Details of the design of such an instrument, which has a constant coefficient to much lower Reynolds numbers than the normal form, are given. The instrument has been thoroughly tested for ratios of orifice area to pipe cross-sectional area up to 0·6. Two forms of the instrument have been developed, for use according as the pipe diameter is greater or less than 100 mm. The instrument is also less sensitive to the usual errors than the normal form. S. G.

See also Abstracts **4102, 4108, 4266, 4267, 4268.**

KINETIC THEORY OF MATTER.

4006. Verification of the Laws of Knüdsen and Reynolds by Radon. W. Mund and A. Luyckx. *Ann. Soc. Sci. de Bruxelles*, 56. *pp.* 196–219, *June* 20, 1936.—The essential parts of the arrangement used are a pair of small cylinders in one flat end of each of which is a hole (A) of definite dimensions, and inside a removable disc (B). Both are enclosed in a spherical pyrex vessel maintained at uniform temperature and containing a minute amount of H_2 and means by which a small quantity of Rn can be released, the combined pressure of H_2 and Rn being such that the mean free path is of the order of 1 m. The cylinders can be placed so that the holes A are at various positions relative to the centre of the vessel. The resultant activity ou B due to the Rn passing through A during a definite interval measures the number of atoms thereof traversing the area of the holes A during that interval. In this way Knüdsen's cosine law is verified. A similar method extends the proof to the case of non-uniform temperature, and thence to a confirmation of the Reynolds law. C. A. S.

***4007. Theory of Brownian Motion of a Critically Damped Galvanometer. K. F. Niessen.** *Physica*, 3. *pp.* 841–854, *Aug.*, 1936. *In German.*—A critically damped galvanometer is short-circuited through a known resistance and inductance. The galvanometer needle is, initially, put at a deflection u and with no initial velocity. It is then left to its Brownian motion due to the fluctuating currents in the circuit. The position $u(t)$ of the galvanometer after a time is measured, and the procedure repeated many times. The statistical average of $u^2(t)$ which can in this way be determined, has been calculated and shown to have a minimum for a certain time depending on the temperature, the constants of the galvanometer and the circuit, and Boltzmann's constant. This method can, therefore, be used to determine Boltzmann's constant. R. P.

See also Abstracts **4043, 4044, 4103, 4169, 4218, 4264, 4283, 4323.**

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

4008. Precision of Length Comparisons with Invar Wires. C. Oltay. *Bull. géodésique*, 50. *pp.* 167–172, *April–May–June*, 1936.—It is shown that if a short standard base and one of the bases of a normal system of triangulation are compared under suitable circumstances by means of a 24-m. invar wire, then the precision attainable by expressing the result in terms of the international metre is 1 part in 2×10^6, whereas for a result expressed in terms of the length of the standard base the precision is raised to 1 part in 6×10^6. This difference arises because in the relative method the precision is not affected by the constant and systematic errors due to establishing the equation of the wire in terms of the metre and only involves the accidental errors arising in the use of the wire. It is suggested that comparisons in terms of a standard base, established in a geologically stable region, would serve excellently for expressing the bases of triangulation intended for measurement of meridional and parallel arcs. H. B.

4009. General Mechanical Measurements. W. Keil. *Die Physik*, 4. 3. *pp.* 77–92, 1936.—A report is given of recent developments in the measurement of length, mass and time. Special sections deal with gauges and screws, angle measurements, determinations of velocity and acceleration, and measurements of gravity by pendulum. References to original papers are given, together with indications of the accuracy now attainable in the various classes of measurement. H. B.

***4010. Photoelectric Extensometer for Very Small Gauge Lengths. E. Lehr and H. Granacher.** *Forsch. IngWes.* 7. *p.* 201, *July–Aug.*, 1936.—Correction of equation for f on page 74 of the original [see Abstract 2001 (1936)].

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 4009.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

4011. Matrix Treatment of Physical Problems. J. F. Wood. *Univ. Durham Phil. Soc., Proc.* 9. 4. *pp.* 217–227, 1936.—Some classical problems such as the interaction of electric circuits and the theory of radioactive transformations, which depend on n linear differential equations of the first order in n variables, are treated by the use of matrices. G. C. McV.

4012. Statistical Measurements. W. Bothe. *Phys. Zeits.* 37. *pp.* 520–522, *July* 15, 1936.—It is often argued that the certainty of a conclusion based on a series of counter experiments may be increased by showing that if the series is subdivided into two parts, each separate part shows the same features as the whole series. This argument is shown to be wrong. Such a comparison of partial series can only serve as check against other than statistical errors. Formulæ are given for the probability of independent events occurring "in pairs," *i.e.*, of the time-interval between two subsequent events being less than the preceding and following interval; similarly, for groups of three, four, etc., events. R. P.

4013. Criticisms of Theory of Probability. H. Jeffreys. *Phil. Mag.* 22. *pp.* 337–359, *Aug.*, 1936.—This paper is in answer to various criticisms, mostly connected with the principles of non-sufficient reason and inverse probability, of the author's publication *Scientific Inference*. A paper by Eddington [see Abstract 2203 (1933)] is used to give point to the assertion that in attempting to avoid the theory of probability the hypotheses of the theory are sometimes unconsciously used. "Significance" and " chance " are discussed at some length. Finally the author maintains that while he often differs from others on fundamental principles, it frequently happens that his theory gives the generally accepted decision, while other theories give opposite results. P. H. B.

4014. Theory of Errors. H. Kaiser. *Zeits. f. techn. Physik*, 17. 7. *pp.* 219–226, 1936.—The theory of errors of observation is worked out on the basis of probability theory. G. C. McV.

4015. Inductivity and Field-Strength. L. Puccianti. *Accad. Lincei, Atti*, 23. *pp.* 643–646, *May* 3, 1936.—The author replies to a note by Giorgi [see Abstract 3354 (1936)] and prefers units in which the permeability *in vacuo* is unity. R. P.

4016. Determination of Absolute Units. N. Campbell. *Phys. Soc., Proc.* 48. *pp.* 708–718 ; *Disc.*, 718–722, *Sept.* 1, 1936.—This paper deals with certain considerations involved in the determination of a system of absolute electrical units. One of the many alternative methods, by which the electrical units might be calibrated, is selected, and analysed with a view to determining what experimental laws might be used, and how the arbitrary assumptions, necessary to fix the units, are introduced in connection with them. The result is given diagrammatically, and it is shown that, both in their identity and in their inter-relations, the propositions set forth in the diagram are different from those usually set forth in discussions of how absolute units should be determined. It is suggested that the usual expositions are incomplete and only attain their apparent simplicity by concealing difficulties and complexities. J. S. C.

***4017. Calculating Machines and Accuracy. F. Emde.** *Zeits. f. Instrumentenk.* 56. *pp.* 265–275, *July*, 1936.—A general investigation is described of the conditions which should be fulfilled by a calculating machine in order to satisfy normal requirements of accuracy without giving unnecessary figures in the results produced. It is shown that the common arrangement of *n*-figure capacity in two of the registers with 2*n*-figure capacity in the products register is unpractical, and that it is better to have all three registers of equal capacity. Also, each register should have sufficient capacity for dealing with 2 or 3 more figures than are required in the final result. Other modifications of the usual arrangement of calculating machines are suggested which should lead to improved efficiency in their use. H. B.

See also Abstracts 4031, 4032, 4263, 4283.

MECHANICS, CLASSICAL.

4018. Dynamical Systems of Variable Mass. C. Agostinelli. *Accad. Sci., Torino, Atti*, 71. 1. *Disp.* 2a. *pp.* 254–272, *Jan.–April*, 1936.—Adopting Newton's second law of motion in the form ; *rate of change of momentum = applied force*, the author works out the dynamics of systems of particles whose masses vary with time, the particles being subject to constraints. It is shown that the Lagrange equations retain their usual form ; new energy theorems are deduced. The analysis is extended to the limiting case of rigid systems of variable mass. W. S. S.

4019. Unitary Deduction of the Dynamical Equations of Maggi and of Appell. E. Gugino. *Accad. Lincei, Atti*, 23. *pp.* 406–413, *March* 15, 1936.—A mathematical investigation leading to equations which are identical with those of Maggi and Appell. J. J. S.

4020. Dynamical Equations of Euler-Lagrange according to G. Hamel. E. Gugino. *Accad. Lincei, Atti,* 23. *pp.* 413–421, *March* 15, 1936.—Referring to his discussion of the general character of the equations of motion of a system with *n* degrees of freedom [see preceding Abstract] the author shows that such systems may be represented in a form identical with the general equations which are named by Hamel Euler-Lagrange equations of mechanics. In the case in which the material system is ultimately subject to bonds of pure mobility Maggi's equations are ordinarily identical with those of Euler-Lagrange. J. J. S.

4021. New Results in the Domain of Non-Linear Mechanics. N. Kryloff and N. Bogoliuboff. *Indian Acad. Sci., Proc.* 3*A. pp.* 523–526, *June,* 1936.—Equations of the form $d^2x/dt^2 + n^2x = \phi\ dy/dt$ and $d^2y/dt^2 + n^2y = -\phi\ dx/dt$ are treated for the case where $\phi = p \sin qt$, p being small compared with n. For non-resonance, the first approximation gives the period of value $2\pi/n$; and when n is near $q/2$ (resonance of demultiplication) the period is $2\pi/\{\frac{1}{2}q \pm \sqrt{(\frac{1}{2}q - n)^2 + (\frac{1}{2}p)^2}\}$. H. M. B.

4022. Periodic Analytic Continuation of the Circular Orbits in the Restricted Problem of Three Bodies. A. Wintner. *Nat. Acad. Sci., Proc.* 22. *pp.* 435–439, *July,* 1936.—This is a purely mathematical paper in which the stability character of the periodic orbits which represent isoenergetic analytic continuations of Kepler's circular solutions for positive values of the perturbing mass, is investigated. G. C. McV.

See also Abstracts 4063, 4372.

MECHANICS, QUANTUM.

4023. Analytical Atomic Wave Functions for Light Atoms. S. Rozental. *Acad. Polonaise Sci. et Lettres, Bull.* 9–10 *A. pp.* 501–506, *Nov.–Dec.,* 1935. *In German.*—A more direct method is given than that proposed by Slater [see Abstract 90 (1933)] for setting up analytical atomic wave functions representing close approximations to the Hartree curves. The total energy of the electron configurations is resolved into two parts comprising on the one hand, the kinetic and potential energy and on the other hand the interaction and exchange energy of the electrons. Simplified wave functions are introduced which permit integration of the two partial energies. Parameters appearing in the integrated solution are determined from the condition that the total energy shall be a minimum. Calculations for the Be atom are given by way of an example of the method. J. E. K.

4024. General Laws of Evolution of a Physical System. J. L. Destouches. *J. de Physique et le Radium,* 7. *pp.* 305–311, *July,* 1936.—The paper presents an introduction to the classification of the relativistic quantum mechanics of systems. The conditions which must be satisfied by all theories of evolution of a physical system are surveyed, and supplementary conditions are examined. The imposition of simple and natural conditions on the results of measurements leads to various fundamental consequences, including the existence of a group of transformations and a differential equation of evolution. N. M. B.

4025. Definition of Quantum Mechanical Legality. R. Dugas. *Comptes Rendus,* 203. *pp.* 41–43, *July* 6, 1936.—A general survey of conditions and relations allowed by quantum mechanics contrasted with those of classical mechanics. N. M. B.

4026. Harmonic Oscillator in Dirac's Wave Equation. I. Postępska. *Acta Physica Polonica*, 4. 3. *pp.* 269–280, 1935. *In German.* —As was shown by Nikolsky [see Abstract 3648 (1930)] the Dirac equation for the harmonic oscillator has a continuous spectrum, owing to the possible escape of the electron with negative kinetic energy. There are, however, almost stationary states with a small probability of escape. The energy values belonging to these states are calculated in the approximation of geometrical optics. The probability of escape is given in the same approximation. Only those levels have a physical meaning for which this probability is less than the frequency. R. P.

4027. Dirac Vector Model for Two Non-Equivalent Electrons in the Atom. I. Schaposchnikow. *Phys. Zeits. d. Sowjetunion*, 9. 6. *pp.* 618–629, 1936. *In German.*—By generalisation of the permutation theory of Dirac, Markow [see Abstract 3773 (1935)] has derived an expression for the energy operators for the case of two equivalent electrons in the atom. The present author now investigates the two electron system $(n_1 l_1)(n_2 l_2)$ where the electrons are not equivalent, and establishes, to a first approximation of the disturbance calculus, the correction factors for the energy of the undisturbed system as eigen values of an operator W. The following function of the scalar product of the orbit moment of the undisturbed system $\theta = (m_1 m_2)$ and of the scalar product of the spin $(\overrightarrow{\sigma_1}\overrightarrow{\sigma_2})$ is derived: $W = f_1(\theta) - \frac{1}{2}[1 + (\overrightarrow{\sigma_1}\overrightarrow{\sigma_2})]f_2(\theta)$, where f_1 and f_2 are polymonials whose coefficients are obtained as the sums of the products of the Slater radial integrals with definite numbers. The expression is applied to the cases *pp* and *pd*. The paper is entirely mathematical.
H. H. Ho.

4028. Application of Boundary Equations in Wave Mechanics. H. Welker. *Zeits. f. Physik*, 101. 1–2. *pp.* 95–103, 1936.—The question of boundary conditions in wave-mechanical problems is discussed. G. C. McV.

4029. Existence of Negative Ions in the Frame of the Statistical Model. H. Jensen. *Zeits. f. Physik*, 101. 3–4. *pp.* 141–163, 1936.—The Fermi-Thomas atomic model in its original conception has no place for negative ions. The author now discusses both the defects and advantages of this model and then shows that the numerical integration of a suitably modified Fermi-equation leads to useful atomic radii. In contrast to the calculated ionisation potentials given by the former Fermi-equation, data are now obtained which may be regarded as a good average of the fluctuating experimental values afforded by the different elements. Further, the calculated diamagnetic susceptibilities are now in accord with the measured data. The susceptibility diminution consequent on the fixation of the ions in the crystal lattice is now theoretically evaluated. H. H. Ho.

4030. Quantum Theoretical Calculation of the Alkali Halide Lattice. H. Jensen. *Zeits. f. Physik*, 101. 3–4. *pp.* 164–185, 1936.—The statistical method is now employed for the calculation of the reciprocal effect of the ionic residue in the alkali halides and the validity of the process is discussed. This presentation is now free from certain imperfections which gave to an earlier publication [see Abstract 1449 (1935)] an uncertainty from the quantitative standpoint especially as regards exchange values. The earlier result is confirmed that the Born repulsion forces do not depend upon electrostatic effects but are explained on the Pauli-principle. The consideration of the change based on this method is important for quantitative details, but for the understanding of the forces in the reciprocal effect it is only of minor significance. The lattice constants are given to a first approximation (without consideration of the deformation) and are about 10 % too great; the agreement with the experimental values improves as the lattice structure becomes richer in electrons. The calculations of the compressibilities and of the infra-red frequencies, however, deviate considerably from the experimental data and the causes of the discrepancy are discussed. The second approximation has only been roughly carried out, although it is in general agreement with the experimental data. H. H. Ho.

4031. Probability Relations between Separated Systems. E. Schrödinger. *Cambridge Phil. Soc., Proc.* 32. *pp.* 446–452, *July,* 1936.—The paper first scrutinises thoroughly the variety of compositions which lead to the same quantum-mechanical mixture (as opposed to state or pure state). With respect to a given mixture every state has a definite probability (or mixing fraction) between 0 and 1 (including the limits), which is calculated from the mixtures statistical operator and the wave function of the state in question. A well-known example of mixtures occurs when a system consists of two separated parts. If the wave function of the whole system is known, either part is in the situation of a mixture, which is decomposed into definite constituents by a definite measuring programme to be carried out on the other part. All the conceivable decompositions (into linearly independent constituents) of the first system are just realised by all the possible measuring programmes that can be carried out on the second one. In general every state of the first system can be given a finite chance by a suitable choice of the programme. It is suggested that these conclusions, unavoidable within the present theory, but repugnant to some physicists, including the author, are caused by applying non-relativistic quantum mechanics beyond its legitimate range. An alternative possibility is indicated. [See also Abstract 4864 (1935).] AUTHOR.

4032. Determinism and Physics. B. Russell. *Univ. of Durham Phil. Soc., Proc.* 9. 4. *pp.* 228–245, 1936.—An analysis of the concept of the "observable" in quantum physics reveals that the physicist hypothetically constructs a continuously existing world of observables in which the observer is ignored. The principle of indeterminacy is considered merely to prove that position and momentum have no separate existence, not that what does exist is undeterminable. Again, in quantum theory, probability is only satisfactorily defined as statistical frequency. The author leans to the view that probability in this sense leads to statistical laws for the behaviour of aggregates only when each member of an aggregate does not behave in an utterly haphazard fashion. In other words, when it is implicitly assumed that deterministic law governs the behaviour of each member of an aggregate. In general the author concludes that there is at present no conclusive reason either for or against determinism in physics. G. C. McV.

See also Abstracts **3916, 3939, 3941, 4156, 4191, 4216, 4259, 4281, 4283, 4350.**

RELATIVITY AND ETHER.

4033. Electromagnetic Waves in Friedmann Space. B. C. Mukerji. *Zeits. f. Physik,* 101. 3–4. *pp.* 270–275, 1936.—Representing the gravitational field of the world as leading to a non-static Friedmann metric, the author investigates the propagation of electromagnetic waves in such a world. It is shown that propagation will occur with constant velocity, but the wave-length will increase as the wave progresses. This result points to the instability of thephoton in the gravitational field. W. S. S.

See also Abstract **4355**.

SOLUTION.

4034. Solvation and Determination of Molecular Weights by Means of the Svedberg Ultracentrifuge. W. D. Lansing and E. O. Kraemer. *Am. Chem. Soc., J.* 58. *pp.* 1471–1473, *Aug.*, 1936.—For binary solutions the change in partial specific volumes resulting from solvation or compound formation does not affect molecular weights determined by the sedimentation equilibrium method in any way different from that for conventional methods, in spite of the fact that sedimentation equilibrium is dependent on differences in partial specific volumes. Under normal conditions, with a binary solution, solvation is probably rarely if ever great enough to lead to an appreciable error in molecular weights. For ternary and higher order systems, also, the error in molecular weight by the sedimentation equilibrium method may be evaluated quantitatively without considering the partial specific volume of solvates or compounds formed by sedimenting component. [See Abstract 1507 (1936).] AUTHORS.

4035. Properties of Metallic Solutions. Part II. B. P. Bering and N. L. Pokrovsky. *Acta Physicochimica*, 4. 6. *pp.* 861–872, 1936. *In English.*—An experimental verification of certain theoretical deductions made in Part I [see Abstract 1061 (1936)] is attempted, with special reference to the S. T. of amalgams. A modified form of the Cantor method is used for observing the maximum pressure of drops ***in vacuo*** and in pure dry H_2; ***in vacuo***, a value of 410 dynes/cm. is obtained for the S. T. of Hg and in H_2 a value of 465 dynes/cm. In addition, the S. T. of amalgams of the alkalis, alkaline earth and other metals is measured. A description of the apparatus and procedure is given but there are no results, apart from those on Hg. H. J. H. S.

4036. Solubility and Separation Phenomena of Ammonium Phosphates at High Temperatures. E. Jänecke. *Zeits. f. phys. Chem.* 177. *Abt.A.* 1. *pp.* 7–16, 1936.—Solubility phenomena in the system H_2O–NH_3–H_3PO_4 are studied with the aid of a gas-heated rotary oven. A phase-diagram of the system for 0–250° C., with NH_3 content 0–30 % and H_2O and H_3PO_4 0–100 %, is given, defining the ranges of separation of the phosphates $(NH_4)_3PO_4.3H_2O$ (one and two liquid phases), $(NH_4)_2HPO_4$, $(NH_4)H_2PO_4$ and $(NH_4)H_5(PO_4)_2$. L. V. C.

*4037. **Influence of Pressure on the Solubility of Gases. A. Michels, J. Gerver and A. Bijl.** *Physica*, 3. *pp.* 797–808, *Aug.*, 1936. *In English.*—The solubility of CH_4 in water and aqueous solutions has been measured at pressures up to 200 atm. The apparatus is described. The results can be expressed by formulæ of the type $\log c/p = F' + p\cdot\Delta v/RT + \int (pv/RT - 1)\, dp/p$; Δv is independent of p; F' and Δv are different for different solutions. The results indicate a possible relation between Δv and the " contraction " of an electrolytic solution. AUTHORS.

See also Abstracts **3976**, **4208**, **4260**.

SURFACE TENSION AND COHESION.

4038. Relations between Cohesional Forces of Liquids and Their Chemical Constants at the Boiling Point. G. Duch. *Comptes Rendus*, 202. *pp.* 1977–1979, *June* 15, 1936.—The cohesional forces between pairs of molecules in a liquid are considered, and it is shown that, at the temperature at which boiling occurs under a constant pressure, the physical molecules constituting a liquid belonging to one chemical family are drawn together with a force proportional to the square of their respective masses and inversely as a power of the distance between their centres. The proportionality constant and the index are the same for all members of the same chemical family. The liquid state is considered to be an agglomeration of spherical molecules of effective diameter $(M\sqrt{2}/ND)^{1/3}$, where M, D and N are the molecular mass, absolute density and Avogadro's number respectively. R. W. P.

4039. Movement of Contaminated Liquid Surfaces. R. Mérigoux. *Comptes Rendus,* 202. *pp.* 2049–2050, *June* 22, 1936.—The rise and fall of a liquid up the sides of a flask when rotated, and the wrinkles which are seen in front of the wave on a liquid surface when it is contaminated by some impurity, are probably due to the formation of a monomolecular fatty layer at the surface and can be explained by the friction between the liquid and the surface layer. H. M. B.

4040. Theory of Electrocapillarity. Part IV. Interpretation of Electrocapillary Data. S. R. Craxford, O. Gatty and H. A. C. McKay. *Phil. Mag.* 22. *pp.* 359–402, *Aug.,* 1936.—The electrocapillary equation obtained in Parts I, II, and III, of this series [see Abstracts 5185 (1933), 502 (1934), and 2422 (1935)] is explained and applied to three typical electrocapillary systems; a fourth system containing no ionising components is also discussed. The special properties of a completely polarisable interphase are then considered, and reasons are given for believing that the solution-mercury interphase is usually completely polarisable. Ordinary electrocapillary curves of salt solutions are next studied, and certain necessary approximations for interpreting existing data are shown to be valid. The structure of the double layer and the capacities of ions in the layer are dealt with, and the dilution shifts of electrocapillary and charge-potential curves are shown to be capable of yielding considerable information about the structure of the double layer; the question of the potential scale is treated incidentally here. Finally, an attempt is made to give a more precise meaning to the term " specific adsorption "; it is shown that several related phenomena can be explained by means of a single simple hypothesis. Certain difficulties of interpretation, not hitherto appreciated, are pointed out with respect to the effect of non-electrolytes on the electrocapillary curve, and it is shown that a consideration of the capacity of the double layer affords the best basis for discussion. Electrocapillary curves of amalgams are examined, and attention is drawn to a feature hitherto overlooked. It is suggested that the different Galvani potentials of different metals are largely responsible for the displacement of the curve on amalgamation. Two problems in capillary adsorption are treated. The consequences that an equation of the Lippmann form, exact apart from the volume-correction term, must always hold provided that there is only one external circuit, are worked out. H. H. Ho.

4041. Theory of Electrocapillarity. Part V. Definition of Surface Tension. O. Gatty and H. A. C. McKay. *Phil. Mag.* 22. *pp.* 402–409, *Aug.,* 1936.—It was shown in Part I [see Abstract 5185 (1933)], that the consideration of the work done on the idealised apparatus (*i.e.,* one which includes the essential features for measuring surface tension) leads to a definition of surface tension in agreement with that of Laplace and Young. The theory showed unequivocally for the first time, that surface work, defined in terms of the classical surface tension, does *not* include compressional work due to volume changes on emulsification. The treatment given in Part I is, however, incomplete, and the present publication is intended to clarify and supplement it. It is pointed out that the possible compressibility of the containing vessel does not affect the theory, and that in a cylindrical capillary during a movement of the pistons, a particle anywhere in the surface will have a movement normal to the surface superposed on its Brownian movement. The relationship now derived, of a proposed thermodynamic definition of surface tension to the properties of a " physical " surface described anywhere within the interphase between two phases, is shown to be in accord with previous conceptions of surface tension. H. H. Ho.

See also Abstracts **3955**, **4348**.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

***4042. Post Office Speaking Clock.** *Phot. J.* 76. *pp.* 414–416, *July*, 1936.—The speaking clock embodies four glass discs carrying concentric sound tracks photographically recorded, and has associated with them an optical system, photo-cells and a complicated cam mechanism. In this way, each minute of the hours is spoken at the correct instant. A light shutter consisting of a strip of photographic glass negative of a carefully drawn wave-form is used to ensure frequency stability. Accuracy to 0·1 sec. is assured. Provision is made for hourly synchronisation of the clock mechanism to Greenwich time. To maintain the required accuracy at intermediate times, the speed of the mechanism must be kept constant, at least within 1 part in 36,000. These conditions are met by means of a free pendulum, compensation for slight changes in the pendulum rate being obtained. J. E. B.

See also Abstracts **4009**, **4061**.

VISCOSITY, FRICTION AND LUBRICATION.

4043. Viscosity of Gases. P. Guareschi. *Accad. Lincei, Atti*, 23. *pp.* 603–609, *April* 19, 1936.—The simplest hypothesis in dealing with the variation of the viscosity of gases with temperature is that which considers the molecules as more or less associated like elastic spheres and which leads to results not completely discordant with experimental data. If the law of force is represented by the expression $K_1'r^s$ where r is the distance between the molecules and where s varies between 5 and ∞ the general value of the coefficient of viscosity can be put in the form $\eta = A\sqrt{mRT}\,[RT\,(S-1)/K_1]^{\frac{1}{s-1}}$, where A is a numerical constant calculated by Chapman and where for $S = 5$ Maxwell's expression is obtained $\eta \doteq 2/3\ RT/\sqrt{2mK_1}A_2$; whilst for $S = \infty$ η is proportional to $T^{1/2}$ and in general, expressing $\eta = KT^{m_1}$ for $m_1 = \frac{1}{2} + 2/(S-1)$, there is obtained the general law of proportionality of η to a power m_1 of T. Taking the law K_1'/r^s and for S tending to infinity, that is considering the case in which the molecules are very hard η will be proportional to the square root of the absolute temperature. On this basis the following conclusions are reached: (1) The moment of the quantity of motion of a molecule of any gas is a constant for all gases and may be expressed by the relation $n\pi m\bar{v}l = H/a$, and for $n = 1/3$ will be $1/3\ m\bar{v}l = H/\pi a = K/a$. (2) The viscosity of gases is constant for all gases when their coefficient of association is equal to unity, and then $\eta = 1125 \times 10^{-7}$. (3) The viscosity of gases is only a function of the coefficient of association which in its turn is a function of the temperature. (4) For all gases a constant value of the ratio $\sqrt{MT}/\sigma^2 = 3{\cdot}95 \times 10^{16}$ is obtained, which permits of calculating the characteristic temperature T when the value of the molecular diameter is known and *vice versa*. From these facts it results that for $n = 1/3$ the transfer of motion in gases takes place only by translation in perfect correspondence with Chapman's demonstration not only for monatomic molecules but also for diatomic. J. J. S.

4044. Viscosity of Liquids. P. Guareschi. *Accad. Lincei, Atti,* 23. *pp.* 690–695, *May* 3, 1936.—In his paper on the viscosity of gases [see preceding Abstract] the author gave the condition of constancy of the moment of the quantity of motion of the molecules, $m\bar{v}l = H/n\pi$, and hence follows for the viscosity the general expression $\eta = Hc/n\pi a$. The same concepts can be applied to liquids and their viscosity calculated. Since $c = N/V$ where c represents the number of molecules per unit volume, N is Avogadro's number and V is the molecular volume of the liquid $\eta = H/n\pi a \times (N/V)$, where a is the coefficient of molecular association. Knowing the value of these magnitudes a may be calculated which is found to be not far from the values of different investigators. From the values of the viscosity of liquids calculated from the above equation compared with the experimental values of the viscosity or of the coefficients of association, it is seen that when a is known at a given temperature the viscosity can be calculated when a suitable value is given to the number n of rotations that the molecule must complete around its centre of figure during its displacement corresponding to its free path. Thus in liquids the transfer of the quantity of motion is made chiefly by rotation of the molecules and not by translation. The equation used is expressed by $\eta = K/na \times N/V$ in the author's previous paper, and H is constant also for liquids and $= m_H/m_e \times h$, where $m_H/m_e = 1840$ (the ratio between the mass of the atom of H and that of the electron), so $K = H/\pi = m_H/\pi m_e \times h$, where h is Planck's constant. Then the general equation for viscosity is:

$$\eta = m_H/m_e \times h/\pi na \times N/V = 1840/\pi \times h/na \times N/V.$$

For all gases as $n = 1/3$ and $V = \text{constant}$ it is sufficient in order to calculate η at a given temperature to know the value of a corresponding to that temperature. For liquids the values of n and of V must also be known. J. J. S.

4045. Viscosity of Butyric Acid-Water Mixtures. C. R. Bury and J. Grindley. *Chem. Soc., J. pp.* 1003–1004, *July,* 1936.—Viscosity-concentration curves for butyric acid-water mixtures with concentrations 0–100 % are given at − 3°, 0°, 12°, 25° and 35° C. All curves show a marked but unexplained maximum at a concentration depending upon the temperature, the maxima at 0° and 35° being at 71 % and 76 % acid respectively. The curve for − 3° shows an anomalous viscosity in the neighbourhood of the critical solution point (− 3·8° C., 40 % acid) but no discontinuity occurs at the concentration (12 % acid) at which micelle formation has been stated to commence. L. V. C.

***4046. Absolute Viscosity Measurements at the Physikalisch-Technische Reichsanstalt. S. Erk and A. Schmidt.** *Phys. Zeits.* 37. *pp.* 489–496, *July* 15, 1936.—The improved apparatus described employs two capillary tubes in series to permit allowance for the end effect. Improvements include means of inserting the capillaries, pairs of which, of 1, 2 and 3 mm. bore, are interchangeable. Glass tubing worked while in the plastic state around an accurately ground rod is more truly cylindrical in bore than drawn tubing, but has not a smooth inner wall; hence the writers have resorted to the older method of choosing capillaries from available drawn tubing. The accuracy finally realised in viscosity measurement is ± 0·2 %. L. V. C.

***4047. Concentric Cylinder Viscometers. L. Squires and R. L. Dockendorff.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 295–297, *July* 15, 1936.—The advantages and disadvantages of Stormer, Couette and MacMichael viscometers are stated. In contradistinction to previous possibilities it is now shown that by means of a friction factor-Reynolds number plot, it is possible to determine the viscosity of liquids in a concentric cylinder viscometer even when the liquids are so fluid that their motion is turbulent during the determination. Satisfactory results can be obtained for liquids as fluid as water. J. K.

***4048. Modification of the Suspended-Level Viscometer. E. H. Payne and C. C. Miller.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 300–302, *July* 15, 1936.—The modified viscometer is described and illustrated. The advantage of permanently connecting all the tubes at the top of the viscometer with rubber hose to a rigid meter manifold is emphasised. It is pointed out, however, that the suspended-level viscometer is not particularly suited for black oils, because of difficulty in observing the meniscus. J. K.

See also Abstracts 3997, 4345.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

*4049. **Self-Recording Microphotometer of New Design. C. S. Beals.** *Roy. Astron. Soc., M.N.* 96. *pp.* 730–736, *June*, 1936.—A conversion of an earlier instrument [see Abstract 1948 (1932)] into a self-recording type. The optical system is described ; the recording camera resembles in general design a motion picture ; there are two magnifications, ×100 and ×20 ; illustrations are given of the 250-W galvanometer lamp and the electrical system, also of the α Cygni spectrum (two magnifications) in the Hγ region. The instrument's performance exceeded expectation. By H. H. Plaskett's method [see Abstract 1477 (1935)] the author finds for the second curve a resolving power sufficient to separate well over 200 lines per mm. A. S. D. M.

See also Abstract 4080.

COMETS AND METEORS.

4050. Surface Features of Meteorites. H. H. Nininger. *Am. J. Sci.* 32. *pp.* 1–20, *July*, 1936.—Some 6000 meteorites (4845 stones, the rest irons or mixed stone and iron) were examined. Of these 5·4 % showed orientation, but this proportion was so distributed as to show that orientation is more frequent in irons (28 %) than in stone, and in cases where the velocity of flight has been highest, thus pointing to its being due to continued flight at high velocity in unchanged direction. As regards shape the majority of oriented meteorites travelled broadside on ; and spheroidal is more common than conical brustzeite. Pitting is due to differential melting and probably occurs towards the end of luminous flight, when the velocity has decreased so that the average temperature of the surface lies between the melting points of the various constituents. C. A. S.

See also Abstract 4076.

COSMOGONY.

4051. Erroneous Objection to Laplace's Cosmological Hypothesis. G. Armellini. *Accad. Lincei, Atti*, 23. *pp.* 277–280, *March* 1, 1936.—It is pointed out that Poincaré has made a numerical error in his " Leçons sur les hypothèses cosmogoniques " regarding Laplace's cosmological hypothesis. According to Laplace the solar system originated in a rotating nebula in which the regions near the equatorial edge separated themselves and formed a ring. Calling ρ the density of such a fluid ring with angular velocity ω, and f the coefficient of attraction, $\rho - \omega^2/2\pi f \geqq 0$. Or if ρ_m is the smallest possible value of the density of the ring $\rho_m = \omega^2/2\pi f$. Poincaré in the work cited states that taking for ω the angular velocity of Neptune a figure is got for ρ_m which is so great that according to it the total mass of the nebula would be much greater than that of the sun. The author shows that this is a mistake and that the minimum mass of the nebula would be inferior to that of the sun. Laplace's hypothesis is thus strengthened by the removal of an objection. J. J. S.

4052. Moment of the Quantity of Motion of the Planetary System and Laplace's Cosmological Hypothesis. L. Gialanella. *Accad. Lincei, Atti*, 23. *pp.* 598–603, *April* 19, 1936.—Referring to

Armellini's paper [see preceding Abstract] on Laplace's hypothesis, the author discusses the origin of the solar system and calls attention to the known mechanical theorem that whatever may have been the transformations and evolutions of the solar system the moment of the quantity of motion has necessarily remained constant. It is shown that this theorem is perfectly compatible with Laplace's hypothesis provided that it is admitted that the pre-solar nebula has had a crushing sufficiently great, and precisely a squeezing such that its maximum thickness has been only sixteen times greater than the radius of the sun. J. J. S.

4053. Age of the Milky Way. H. Mineur. *Astrophys. J.* 84. *pp.* 113–131, *Sept.*, 1936.—The dynamical consequences of a variation in the masses of the stars, treated in accordance with the theory of relativity, are discussed : the motion of such a mass in a given gravitational field is the same as that of a constant mass. As a first approximation, Newton's law holds. The diminution in the masses of the stars causes our Milky Way system to expand in inverse proportion to its mass, and the velocities increase in proportion to the mass. As a result of the variation in the masses of the stars, the equipartition of energy for various groups of stars is upset, and the effect of the passages is insufficient to re-establish the equipartition. A study of the mean energy of various groups of stars enables the age of the Milky Way (or at least an upper limit for this age) to be made assuming that equipartition of energy existed at the time when the stars were formed. A numerical evaluation of the equipartition of energy leads to the conclusion that the interval of time since the formation of the stars cannot be greater than approximately 10^{10} years. The possibility is therefore considered that the stars have, since their formation, retained very nearly the same masses and have not undergone a process of evolution such as has been generally accepted. This result is in agreement with the hypothesis of the origin of the Milky Way proposed by G. Lemaître as a result of his theory of the expanding universe. AUTHOR.

See also Abstract **4059.**

NEBULÆ.

4054. Spacial Structure and Mass of the Planetary Nebula NGC 6572. B. Vorontsov-Velyaminov. *Zeits. f. Astrophysik*, 12. 4. *pp.* 247–259, 1936. *In English.*—Spectrophotometric measurements made by Berman (*Lick Observat. Bull.*, No. 430, 1930) are used to calculate the spacial photometric density of the nebula in the different monochromatic radiations. This spacial density is reduced to the numbers of excited H, He and O atoms per $cm.^3$ of the nebula as a function of the distance from the nucleus. The total mass of the H, He and O nebular envelopes is 0,007, $\sim 10^{-4}$ and $\sim 10^{-7}$ that of the sun. AUTHOR.

4055. Identification of Forbidden Lines. J. C. Boyce. *Roy. Astron. Soc., M.N.* 96. *pp.* 690–698, *May*, 1936.—This paper comprises a revision and extension, in the light of recent observations and analytical advances, of the summary of forbidden lines in the spectra of gaseous nebulæ compiled at the beginning of 1935 by Bowen [see Abstract 625 (1935)]. Four tables of lines are given ; Table I comprises observed forbidden lines and unknown lines the classification being with respect both to observed and calculated wave-lengths and subdivided into nebular, auroral and trans-auroral divisions ; Table II contains the wave-lengths of all forbidden lines which have not been observed in gaseous nebulæ spectra but which might be expected to appear ; Table III comprises an index of forbidden lines grouped with respect to elements; Table IV comprises a list of forbidden lines observed in the spectra of light Novæ. Detailed remarks on the identification and classification of the lines are included, particularly in the more doubtful cases. J. E. K.

4056. Surface Brightnesses and Cosmic Absorption in the Spiral Nebulæ. M. S. Eigenson. *Zeits. f. Astrophysik,* 12. 4. *pp.* 213–232, 1936.—Investigation of the mean photographical surface brightness of spiral nebulæ reveals that the strong dependence on the inclination of the spiral to the radius of vision is due to the presence of cosmic absorption by dark matter in the equatorial zones of the nebulæ. The optical thickness of the absorbing layer in a typical spiral is about $0^m{\cdot}6$ in the polar direction and about $2^m{\cdot}24$ in the equatorial zone, the relative absorption in the zone of influence being $0^m{\cdot}78$. The mean coefficient of photographic absorption is estimated to be $0^m{\cdot}8/1$ kpc from which it follows that the geometrical polar thickness of the absorbing layer is 750 parsecs. Comparison of photographical and visual surface brightnesses reveals the presence of selective absorption in the spirals. Typical values of the visual and selective polar optical thicknesses are $0^m{\cdot}4$ and $0^m{\cdot}2$ respectively. There is a noteworthy agreement between the various numerical data obtained and corresponding data for the Milky Way which lead to interesting conclusions concerning the identity of the Milky Way and the spiral nebulæ. J. E. K.

4057. Scattering of Light in Diffuse Nebulæ. O. Struve and Helen Story. *Astrophys. J.* 84. *pp.* 203–218, *Sept.*, 1936.—The degree of obscuration of faint background stars has been estimated for 91 nebulæ, of which 68 were listed by Hubble in his study of the origin of nebular luminosity. Nebulæ having continuous spectra are associated with an appreciably greater degree of obscuration than nebulæ having emission spectra. The difference is of the order of 0·6 mag. The nebulæ in the Pleiades are much less efficient in reflecting starlight than are the nebulæ near ρ Ophiuchi and near ν Scorpii. An application of Seeliger's theory to the nebulæ having continuous spectra leads to a determination of the albedo p of the particles, provided the opacity is complete. This condition is probably nearly fulfilled in the region of ρ Ophiuchi, for which $p = 0{\cdot}7$. For the Pleiades $p = 0{\cdot}03$, but this value includes departures arising from a lack of opaqueness. The high value for the nebulæ near ρ Ophiuchi is probably not real and may be caused by absorption. AUTHORS.

4058. Luminosity Function of Nebulæ. Part I. E. Hubble. *Mt. Wilson Observat., Contrib. No.* 548. *Astrophys. J.* 84. *pp.* 158–159, *Sept.*, 1936.—The brightest star, arbitrarily defined as the mean of the three or four brightest individual, non-variable stars in a nebula, is calibrated as a criterion of distance ($\overline{M}_s = -6{\cdot}35$, $\sigma_s = 0{\cdot}41$). The luminosity function of resolved nebulæ is then derived from the frequency distribution of $m_s - m_n$, which measures the luminosity of a nebula in terms of its brightest star as the unit. The luminosity function approximates a normal error-curve with $M_{0n} = -14{\cdot}2$, $\sigma_n = 0{\cdot}85$, and $\overline{M}_n = -15{\cdot}18$. Incomplete data for brightest stars in members of the Virgo cluster suggest a modulus, $m - M$, of 26·6 or slightly larger. Cluster members are roughly comparable with resolved field nebulæ, and, within the cluster, different types of nebulæ are comparable among themselves. AUTHOR.

See also Abstracts 4072, 4073.

PLANETS.

4059. Origin of Solar System. J. Larmor. *Observatory,* 59. *pp.* 212–215, *July,* 1936.—The unsolved domain in Newtonian celestial dynamics is the mode of origin of the solar system. The author considers the Laplacian suggestion and rejects it because the conserved rotational momentum is principally in the planetary motions and not in the central mass; incidentally this might indicate the non-rotation of vast nebulous stars and the rapid rotation of shrunken ones like the companion to Sirius. His rejection would also include the solar system originating through the flick of a small and near passing star or the prolonged influence of a great and distant one. He suggests and again rejects the origins of the inner planets from the sun's jets, and of the outer planets from the disturbing star jets, the unstable asteroidal belt marking their limits. A. S. D. M.

4060. Photoelectric Measures of Uranus. W. A. Calder. *Harvard Coll. Obs., Bull. No.* 903. *pp.* 11–15, *May* 1, 1936.—The author gives a table of photoelectric measures of Uranus (Stebbins classifies its colour as that of a star, Class F9) and two stars of mp_g 6·22 and 7·42 and spectrum, F_0 and F_5, from Oct. 29, 1934, to Feb. 7, 1935; finding its surface very uniform in longitude, but with a slight increase of brightness in 1935, perhaps due to increase of solar radiation. Measures in 1935–6 later were with stars of mp_g 6·20 and 6·10 and spectrum A_2 and F_5; up to the present they show no appreciable rotational effect from a photometric view-point, nor have they confirmed Becker's results [see Abstract 1896 (1934)]. He finds that the planet has increased from Stebbins' photoelectric measures in 1927 (6·06 mag.) to his own in 1936 (5·94 mag.), but this may be due to geometrical considerations. A. S. D. M.

4061. Irregularity of Earth's Rotation. N. Stoyko. *Comptes Rendus,* 203. *pp.* 39–40, *July* 6, 1936.—Long period irregularities in the earth's rotation are indicated by the motions of the moon and planets; short period irregularities from the rates of clocks of great precision. The author gives a table and diagram of daily rates (in monthly means) from January 16, 1934, to April 5, 1936. The diagram compares the clock rates of the Bureau International de l'Heure and those of the Institut Physico-Technique of Charlottenburg, each curve representing the sum of the errors due to rotation irregularity and to the rates; the difference between the two curves (which are very similar) being due solely to the differences of the clocks themselves. For the period October, 1934, to August, 1935, the Paris clock slowed by $0^s{\cdot}39$ and the Institute clocks by $0^s{\cdot}35$, but it is not yet possible to recognise whether this irregularity in the earth's rotation is periodic in character. A. S. D. M.

STARS.

4062. Method of Simultaneous Pupillary Regions. J. Lagrula. *Comptes Rendus,* 202. *pp.* 1972–1974, *June* 15, 1936.—The method in stellar photometry which consists in photographing successively the image of the aperture of the observing instrument by the light of the sources which it is required to compare, is modified so that the two images can be photographed simultaneously. G. C. McV.

4063. Calculating Method for Solution of the Integral Equation of Stellar Statistics. A. Brill. *Zeits. f. Astrophysik,* 12. 2–3, *pp.* 128–139, 1936.—The discontinuously changing star numbers $a(m_0 + n)$ are developed into a smooth sequence, m_0 being an initial brightness and

$n = 0, 1, 2, 3$, etc. The smoothed star numbers give directly mean density values. The absolute brightnesses Mn are determined from the gradients $d(\log a(m_0 + n) - 0\cdot 6n)/dn$. The sudden changes in the observed star numbers are conditioned by the abrupt change of abundance of absolute bright stars in the star groups n. J. E. K.

4064. Relation between Emission Intensity and Violet Displacement of Absorption Lines in the Spectrum of P Cygni. T. Araki and M. Kurihara. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 125–127, *May,* 1936. *In German.*—A qualitative relationship between the intensity of absorption and emission lines on the one hand and the violet displacement of absorption lines on the other hand in the spectrum of P Cygni has recently been discovered independently by Beals and Struve. It is found possible to set up a corresponding quantitative relationship between emission intensity and displacement of absorption lines by reducing to a common standard and utilising recent intensity observations by Elvey, Struve and Beals of P Cygni type spectra. This relation is expressed by $\log_{10}Q = -0\cdot 23\ (V + 20)$ where V is the mean velocity of the absorption lines and Q is the sum of $Q(\lambda)$ over all emission lines, $Q(\lambda)$ being proportional to the number of emission quanta of wave-length λ. J. E. K.

4065. Spectrophotometric Criteria of Pseudo-Cepheids in Low Dispersion. Wilhelmina Iwanowska. *Astron. Iakttagelser och Undersökning, Stockholms Obs.* 12. 5 [24 *pp.*], 1936. *In English.*—The author seeks criteria for separating supergiants of classes F, G and K from other stars, by using spectra of low dispersion. Diagrams give values of k and c against g-Hγ [see Abstract 1898 (1934)], where c is the cyanogen, and k the colour-equivalent as given by the inclination through $\lambda\lambda$4400 and 4050; g is the magnitude difference at two maxima adjoining the G-band (λ4260 and λ4560); Hγ is the hydrogen line measured relative to the straight line of these two maxima when the energy-curve is plotted in the prismatic scale. On diagrams lines are traced separating supergiant regions, from the ordinary stars; a star in both diagrams in this region is a supergiant; if close to the limiting line, it is doubtful, and appeal is made to its shape in a detailed energy curve. These criteria hold best for G-type; less well for F-type but here the continuous hydrogen absorption beyond the Balmer series limit gives a strong luminosity effect; they are of little use for K-type supergiants. A. S. D. M.

4066. Theoretical Capture Spectrum of Hydrogen. G. G. Cillié. *Roy. Astron. Soc., M.N.* 96. *pp.* 771–779, *June,* 1936.—The relative intensities of the Balmer lines up to H_{10} in a capture spectrum are found. The theoretical intensities of the early members of the series are found to be unaffected by the later states. The intensities of the lines per unit wave-number relative to the continuous spectrum at the Balmer limit are given. They agree best with observations of the chromosphere at an electron temperature of 10,000°, but are a hundred times too small in the case of planetary nebulæ. Considerable self-reversal is therefore postulated for these nebulæ. But the intensities should show little variation with electron temperature and the amount of self-reversal, which again seems contrary to observations of planetary nebulæ. G. C. McV.

4067. Non-Coherent Dispersion and the Formation of Fraunhofer Lines. L. Spitzer, Jr. *Roy. Astron. Soc., M.N.* 96. *pp.* 794–807, *June,* 1936.—The theory of Weisskopf and Wigner for the probability of cycles of transitions is applied to the formation of Fraunhofer lines. The atoms are assumed to have a ground and two upper states. The transfer of radiation from the wings to the centre of a line and *vice versa* is calculated. In the most important case, the effect of coupling is very considerable in the wings, although its effect on the central intensity may be negligible. G. C. McV.

4068. Star Models with High Central Condensation of Density. M. Krook. *Roy. Astron. Soc., M.N.* 96. *pp.* 761–771, *June*, 1936.—A perfect gas polytrope of index 4½ is used to calculate the value of the opacity coefficient from the usual equations of stellar equilibrium under the assumption of uniformly distributed energy sources. Data are those for the sun. The opacity coefficient is next calculated from Stromgren's formula ($K \propto \rho/T^{3.5}$) for the same model. Increasingly great discrepancies between the two values so found occur on proceeding from the centre of the star outwards. To correct this it must be assumed that energy generation increases outwards and is greatest near the outer envelope of the star, which is physically unlikely. A general theorem is then proved, giving the limitation which must be placed on the ratio of radiation to total pressure at the centre of the star in order that no outward increase of energy generation should occur. G. C. McV.

4069. Ionisation and Excitation in the Upper Layers of an Atmosphere. A. Pannekoek. *Roy. Astron. Soc., M.N.* 96. *pp.* 785–793, *June*, 1936.—The correction factor for the Saha ionisation formula is calculated, allowance being made for the fact that the radiation passing through the outer layers of the star is not black-body radiation. For hydrogen stars the correction factor comes out at about 0·7 for temperatures lying between 25,200° C. and 10,080° C. For the solar atmosphere, the value is about 0·6. The new value of the excitation in the upper layers is also given. G. C. McV.

4070. Analysis of Two-Phase Stellar Configurations. R. C. Majumdar and D. S. Kothari. *Zeits. f. Astrophysik*, 12. 4. *pp.* 263–280, 1936. *In English.*—The general case is worked out for two-phase configurations on the standard model, the envelope satisfying Emden's equation of index n_1 and the core satisfying Emden's equation of index n_2. The case when the index n_2 tends to infinity (Emden's *isothermal* case) is also included. With the help of a simple transformation any equation referring to (n_1, n_2)-finite case is easily transformed to the case n_1 finite, n_2 infinite. The formulæ for the physical variables like radius, central temperature, central density, etc., are all given for the general boundary conditions that the density $\rho \to \rho^*$ and temperature $T \to T^*$ at $r \to r_1$, where r_1 is the external radius of the configuration. AUTHORS.

4071. Colour Excess in h and χ Persei. S. L. Thorndike. *Harvard Coll. Obs., Circ. No.* 416 [7 *pp.*], 1936.—Measures have been made of 10 objective-prism spectrograms of the double cluster in Perseus, taken by Rieke, the chosen wave-lengths being between λ4020 and λ6440. The brightest early-type stars are much redder than nearer stars of the same spectral classes, and this may be due to selective interstellar absorption. A possible correlation of redness with absolute magnitude is discussed, and the results are compared with those of Oosterhoff who studied the fainter stars in this cluster. M. A. E.

4072. Selective Absorption of Starlight by Interstellar Clouds. F. H. Seares. *Nat. Acad. Sci., Proc.* 22. *pp.* 327–331, *June*, 1936.—Stars in the region of an obscuring cloud may show general, selective, or no

absorption according to the positions of the stars and the nature of the cloud material. The author gives the colour results for groups of stars between pg. mags. 10–13·5, in 30 Kapteyn selected areas from wide galactic latitudes. A table of 42 groups — 19 normal and 23 with colour excess — shows the inference of obscuration [see Abstract 95 (1934)]; all but 3 normal colour groups are mostly in zones of avoidance, or bordering zones of partial obscuration. The colour excess change with latitude is real; there is not enough data to correlate with longitude. Ao stars in unobscured regions give a mean colour index on the IPg-IPv system of − 0·14 (with ± 0·02 or 0·03 uncertainty), and not zero, since the polar region is covered by a veil of obscuration. For 271 stars north of 80° dec., the mean colour-index for Ao is − 0·04. Selective absorption is widespread and closely related to the surface density of extra-galactic nebulæ. But the colour-excess rarely exceeds 1 mag. [See Abstract 1789 (1933).]
A. S. D. M.

4073. Absorption and Space Reddening from Colours of Galactic Globular Clusters. J. Stebbins and A. E. Whitford. *Mt. Wilson Observat., Contrib. No.* 547. *Astrophys. J.* 84. *pp.* 132–157, *Sept.*, 1936.—For atmospheric extinction, the total value $= 0^{M}\cdot 30$ sec. z, the differential $= 0^{M}\cdot 06$ sec. z; the latter is small compared with apparent colour dispersion in globulars. A table is given of the observed magnitudes and colours of 68 globulars. Their colours are correlated with the number of nebulæ or the richness of the stars in the region; when the colour excess, $E > + 0^{M}\cdot 20$, no nebulæ are found, when $E < 0^{M}\cdot 19$, there are nebulæ; nearby obscuration as shown by scarcity of low latitude stars give strongly coloured globulars. As with B stars, Hubble's zone of avoidance approximates to the limits of the reddened clusters; the outer clusters are of uniform colour = about F6 stars; those near the glalactic equator = M stars. The main absorbing region is probably 8°·5 wide. The correction factor for Shapley's distances becomes $\log f = - 0\cdot 05$ cosec.$|b|$. The globular system is incompletely seen; the cluster concentration towards the centre is on the sun's side of it; the galactic diameter is nearly 30,000 parsecs. and of the order of size of the Andromeda nebula. A. S. D. M.

4074. Early Stages of Nova Herculis. Part I. Continuous and Absorption Spectra. F. L. Whipple and Cecilia P. Gaposchkin. *Harvard Coll. Obs., Circ. No.* 412. [10 *pp.*], 1936.—The distribution of energy in the continuous background of the Nova's spectrum has been measured from 26 plates taken at Harvard between 1934 Dec. 14 and 1935 April 6. The effective temperature is found to increase as the magnitude decreases, the mean being 10,000°. Measurements have also been made of the H, ionised Ca, and ionised Fe absorption lines, and of the absorption CN bands. M. A. E.

4075. Continuous Ejection Theory and Nova Herculis. F. L. Whipple and Cecilia P. Gaposchkin. *Harvard Coll. Obs., Circ. No.* 413. [11 *pp.*] 1936.—The observations of the Nova are shown to be consistent with the theory of continuous ejection of matter from the star during the outburst, and furnish evidence that on the average the density of matter at any point in the Nova's atmosphere is proportional to the net outward flux of radiation. Approximately ten earth-masses were involved in the ejection up to the May minimum, and the mass responsible for the observed duplicity of the star after this is probably considerably larger. The subsidiary processes are discussed. M. A. E.

4076. Observations of Solar Eclipse of 19th June, 1936, of Nova Lacertae; and of Comet Peltier. E. Esclangon. *Comptes Rendus,* 202. *pp.* 2021–2022, *June* 22, 1936.—Observations were made of last contact of the eclipse at the observatories of Paris, Meudon, Besançon and Bourges. At Meudon, d'Azambuja also observed Hα with the spectrohelioscope, and Baldet and Camichel obtained 5 spectrograms of Nova Lacertae [see following Abstract] giving for H and K, and also for Hα the velocity — 1400 km./sec. At the Astrophysical Station in Haute-Provence, de Kerolyr obtained photographs of Comet Peltier, showing it as a nebulosity of about 2′ but without tail; and at Meudon, Baldet observing it with the spectroscope found very intense bands of molecular CN at λ3883.
A. S. D. M.

4077. Nova Lacertae. R. K. Young. *Roy. Astron. Soc. Canada, J.* 30. *pp.* 209–211, *July–Aug.*, 1936.—The author gives a map of the Nova's position just within the constellation Lacerta, R.A. 22h. 12·0m., Dec. 55° 7′ (1900) and spectrum plates for June 20–22. Its magnitudes were on June 19, 20, 21 and 24, 2·4, 2·2, 3·0 and 4 respectively. Its spectrum was, on 19–20, of the α Cygni type with velocity — 1075 and — 1180 km./sec. the interstellar Ca lines being sharp and strong; on the 21st the absorption spectrum changed to emission bands with velocity — 1510 km./sec. Subsequently the emission bands grew stronger with central absorption, and velocity increasing from 1690 to 1930 km./sec. A. S. D. M.

4078. Spectroscopic Binary, H. D. 34762. W. H. Stilwell. *Roy. Astron. Soc. Canada, J.* 30. *pp.* 212–214, *July–Aug.*, 1936.—This star (Boss 1273) of R.A. 5h. 14·7m., Dec. 27° 51′ (1900) is an early type Star (B_9) of visual mag. 6·30, with broad, fuzzy spectral lines, but Hγ and Hδ were fairly well-defined on all of the 13 plates, and a table is given of these measures. The final elements are P = 5·4197 days, K = 25·5 ± 2·59 km./sec., $\gamma = +4{\cdot}8 \pm 1{\cdot}86$ km./sec., $e = 0{\cdot}00$, $\omega = 270°$, T = 1935 Dec. 4°.695 ± 0·002, $a \sin i$ = 1,900,000 km. A. S. D. M.

4079. Star Catalogues, Especially Those of Fundamental Character. A. Kopff. *Roy. Astron. Soc., M.N.* 96. *pp.* 714–730, *June,* 1936.—A fundamental catalogue is defined by its stars' positions (free from systematic errors) and proper motions (well selected over the whole sky) and by the numerical value of the precession constant; if this last is changed, so are the proper motions. The author accepts as fundamental Auwers' N.F.K. and Boss' P.G.C., and both use Newcomb's value of precession. In the future, spiral nebulæ may serve, separating apparent precessional from the real stellar proper motions. He describes his own method of revising N.F.K., and the question of systematic differences; those in Dec. chiefly through telescope flexure, and to be corrected by solar and (inner) planet observations; those in R.A., which concern chiefly the equinox, by means of three catalogues (Greenwich 1860–1925, Pulkowa, 1845–1915, Cape 1860–1905); modern instruments and clocks (especially crystal) give the R.A.s nearly free from systematic error. Stellar distribution should be referred to the fundamental galactic plane, and stars should be selected to fill gaps rather than for comparison with past observations. The aim of the "Second A. G. Catalogue" is the photography for star position to the 9th magnitude and to obtain 30,000 stars regularly distributed in both hemispheres. A. S. D. M.

***4080. Simple Method of Producing Intensity Scales. E. J. Meyer.** *Zeits. f. Astrophysik,* 12. 2–3. *pp.* 123–127, 1936.—The construction and calibration of a new apparatus based on the principle of the tube photometer is described which renders possible the production of accurate intensity marks on a plate during the photography of a star. Some experimental results are given to illustrate the performance of the apparatus. J. E. K.

See also Abstracts 4053, 4055, 4057, 4058, 4082, 4161.

SUN.

4081. Height of Chromosphere in 1935 and Course of Solar Cycle. G. Abetti. *Accad. Lincei, Atti,* 23. *pp.* 463–464, *April* 5, 1936.—In continuation of former observations made at Arcetri, Prague, and Catania, it is found that the mean height of the sun's chromosphere in 1935, derived from results at the three observatories, is lower by 0″·15 than in 1934, and that the chromosphere was highest and the difference between poles and equator least in the minimum year of 1933. The total area of the prominences in 1935, deduced from observations at Arcetri, Prague, Catania, Tashkent, and Zurich, shows a rapid increase in solar activity, which is confirmed by the appearance of 5 very large spot-groups, all in the southern hemisphere. The advance towards maximum has been more rapid in the south than the north, for the zone of maximum prominence activity has moved 7° nearer the south pole, but only 2° nearer the north pole, since 1934; also the secondary maximum in comparatively low latitude has now appeared, and is well-marked in the south but scarcely perceptible in the north. The activity of bright and dark markings on the disc has also increased from 0·5 to 1·5 on the scale of the character figures. M. A. E.

4082. Speed of Corpuscles Ejected from Stellar Atmospheres. Y. Hagihara. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 122–124, *May,* 1936. *In English.*—The acceleration of an atom subjected to radiation-pressure is calculated, allowance being made for the fact that the atom may exist in either a normal or an excited state. The resulting expression for the acceleration does not contain the transition probabilities between the states. The present theory therefore gives the same speed for the singly ionised Ca atoms of the sun as does that of Milne. G. C. McV.

4083. Intensity of Total Radiation from Sunspots and Faculæ. T. W. Wormell. *Roy. Astron. Soc., M.N.* 96. *pp.* 736–749, *June,* 1936.—A thermocouple with a galvanometer behind the screen aperture gives great speed of response. Errors from scattering and selective absorption by the atmosphere and optical train, just outside and inside the sun's limb and towards its centre, are discussed. For scattering a distribution of intensity $(a/\pi)e^{-ar^2}$ is found where r is the distance from centre and a is the scattering parameter. The author got $a = 0{\cdot}065$ for a fairly large spot on July 21, 1935. A table is given of the central intensity and a for spots traversing the disc in 1934 and 1935; and these indicate a real variation in the umbral intensities of individual spots, the larger spots being darker. For spots on July 21 and Oct. 23 (diagrams given), 1935, for the umbra near the disc centre and for the photosphere adjacent, effective temperatures are 4300° K. and 9950° K. respectively. The results are not discordant with the intensity umbra/photosphere, being independent of position on the disc. Faculous intensity is very little greater than photospheric near the centre (0·01), but decidedly greater near the limb (0·10); there may be a variation in the sun's total radiation therefore, as a disturbed area moves across the disc, and might conceivably show up as a solar rotation factor. A. S. D. M.

***4084. Energy Distribution in Extreme Ultra-Violet of the Solar Spectrum. W. W. Coblentz and R. Stair.** *Bureau of Standards, J. of Research,* 17. *pp.* 1–6, *July,* 1936.—Supplementing the data given in a previous publication [see Abstract 2619 (1936)] the present paper gives further calculations and graphs showing the distribution of energy in the extreme u.v. of the solar spectrum, for various air masses traversed by the rays, at a sea-level station (Washington); also the spectral-energy distribution of solar radiation outside the earth's atmosphere, showing that there is no similarity with the radiation of a black body at 6,000° K, which is sometimes used in calculating the u.v. solar spectral energy. The second part of the paper describes progress made in assembling apparatus for measuring the spectral quality and total intensity of u.v. solar radiation by means of a photoelectric cell and filter radiometer transported aloft in sounding balloons. AUTHORS.

4085. Distribution of Brightness in the Fraunhofer Lines of an Atmosphere with Arbitrary Density Distribution. P. Wellmann. *Zeits. f. Astrophysik,* 12. 2–3. *pp.* 140–170, 1936.—The author investigates how the structure of a Fraunhofer line is influenced by the dependence of atmospheric density on optical depth. The effects of density functions on the radiation transport equation are at first considered qualitatively. Closer approximations to a strict solution of the equation are obtained by suitable transformation and from them some general properties of the contours can be deduced. Excessive complication of the equations prevents strict consideration of the increase of temperature with optical depth, but here again sufficient approximation is possible. The practically important questions as to how the density course can be determined from the observed contour and how the line varies with distance from the centre of the apparent solar disc are briefly discussed. Some calculated examples illustrate the method and results. J. E. K.

4086. Limb Darkening and Energy Distribution of Solar Radiation, Derived from Theoretical Absorption Coefficients. M. Minnaert. *Zeits. f. Astrophysik,* 12. 4. *pp.* 260–262, 1936. *In English.*—The limb darkening and energy distribution of the solar spectrum are calculated from Pannekoek's data for the absorption coefficients of a stellar atmosphere as a function of pressure and temperature, the calculation taking account of the increase of temperature and pressure with depth. The results agree better with experimental observations than do those found by Pannekoek. Deviations are explained as due principally to the assumed absorption coefficients being too great in the ultra-violet. L. A. W.

See also Abstracts 4052, 4076, 4100, 4101.

GEOPHYSICS.

GEODESY.

4087. Flattening and Mass of the Earth. H. Passarge. *Gerlands Beitr. z. Geophys.* 48. 1. *pp.* 81–83, 1936.—The fundamental idea is that the mass of the earth rotating and travelling round the sun is greater than that of a similar fictitious earth that only rotates but is otherwise fixed in space; if gravity on the former is g, that on the latter is $\mathrm{G} = g(86144/86400)^2$, while $g-\mathrm{G}$ would be gravity on a second fictitious earth which travelled round the sun without rotating. Hence, regarding the acceleration of gravity as a state of motion rather than as due to attraction of masses it is deduced that the apparent rotation of the earth only affects the lithosphere, the original rotation and that which affects the core being in the opposite direction; the axes of the two rotations are slightly inclined to each other, and the flattening only affects the lithosphere, the amount of which is deduced as $(1-g_0/g_{90})(1-\mathrm{L})^3\delta\sqrt[3]{\Delta/\delta}/\mathrm{M}$, where M is the mass of the earth, L the reduced pendulum length for sidereal time, and Δ, δ the mean densities of the earth and lithosphere respectively. Friction between the oppositely rotating core and lithosphere accounts for terrestrial electricity and magnetism. C. A. S.

See also Abstract 4008.

GEOPHYSICS, APPLIED.

4088. Fizeau Method. H. Löwy. *Beitr. z. angew. Geophys.* 6. 1. *pp.* 47–51, 1936.—The Fizeau method of measuring the distance of electrically conducting surfaces is discussed. It is applied to the problems of the distribution of electric waves through rock, and to radio duplex-telegraphy. W. A. R.

4089. Geoelectric Hydrology. A. Loehnberg and A. Loewenstein. *Beitr. z. angew. Geophys.* 6. 1. *pp.* 52–88, 1936.—For purposes of water supply it is not enough to determine the main underground structures, but the section must be worked out in detail. The authors use the method of electrical resistivity and, by adapting the apparatus to the varying conditions of the soil, with a suitable method of compensation, they claim that they are able to investigate the fine detail of a vertical section with great accuracy. W. A. R.

4090. Apparent Specific Resistances in Bore-Holes. J. N. Hummel and O. Rülke. *Beitr. z. angew. Geophys.* 6. 1. *pp.* 89–99, 1936.—It is found that when the specific resistance at right angles to the rock-strata is measured by the Neumann-Wenner 4-point method, this resistance does not bear any simple relationship to the specific resistances of the individual strata. When resistances are measured for three strata, six discontinuities are shown in the curve, one on each side of the crossing. Special cases are considered and diagrams show the types of results obtained. It is important that calculations should be available for interpreting results obtained from electric bore-hole investigations. H. M. B.

4091. Spreading of Radio Waves Underground (Spark Geology). Basis and Practice of the Capacity Method. V. Fritsch. *Beitr. z. angew. Geophys.* 6. 1. *pp.* 100–119, 1936.—Using an aerial sunk at different

levels, the capacity and the depth are measured and curves drawn for different positions of the lodes. It is noted that the shapes of the curves are considerably affected by the soil and vegetation on the surface also by weather conditions. Before any wholly reliable conclusions can be drawn, it will be necessary to know the dielectric capacities and conductivities of different minerals and the change of these with water content.
H. M. B.

See also Abstract 4095.

HYDROSPHERE, PHYSICS OF THE.

4092. Tides in Oceans Bounded by Meridians. J. Proudman and A. T. Doodson. *Roy. Soc., Phil. Trans.* 235*A*. *pp*. 273–342, *May* 26, 1936.—The general equations for an ocean bounded by a complete meridian are worked out, and thereafter the diurnal tides for the same ocean. As a side-line to the investigation the Fourier expansions of associated Legendre functions are obtained. These are tabulated in an Appendix and their use is explained. W. A. R.

LAND, PHYSICS OF THE.

4093. Internal Structure of the Earth. H. Kawasumi and S. Honma. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp*. 201–221, *June*, 1936. *In English*.—There is some indication of a second-order discontinuity within the mantle of the earth. The assumption of a first-order discontinuity on the results of the Formosa earthquake, 1935, gives results smaller than expected. The surface of discontinuity, if any, lies at a depth of 430 km. from the earth's surface. W. A. R.

4094. Penetrating Radiation as Means for Determining Granite-Gneiss Contact. E. Rothé and Arlette Hée. *Comptes Rendus*, 203. *pp*. 268–270, *July* 20, 1936.—The great difference in the radioactivity of the granite of Bressoir with two micas (practically nil) and that of the porphyroid granite of the Central Vosges (practically double that of any neighbouring rock) usually containing much amphibole, affords a useful method for determining the zone of contact. Thus, within a short distance along the footpath from Brifosse to Chaumes de Lusse the radioactivity falls by over 50 %. C. A. S.

4095. Proportion of Emanation in Ground Air. H. Israël-Köhler and F. Becker. *Gerlands Beitr. z. Geophys.* 48. 1. *pp*. 13–58, 1936.—Theoretical speculation and experimental determinations are given of the condition of emanations in air obtained from the ground, and from the dependency of the pressure of Rn at different depths, the existence, form and depth of the tectonic heterogeneity can be predicted. Such experiments form a supplementary method of geophysical survey, which can be further augmented by measuring gases (CO_2; CH_4) which do not dissociate. The depth, for which geological heterogeneity is perceptible by emanation at the surface is limited by the " prolificness " of the source of interruption. The most reliable analysis is the one based upon the concentration of atmospheric pressure in a relatively short depth. A review of the methods of determining the Th emanation in the ground air and some results of orientating surveys are given. H. M. B.

4096. Direct Determination of the Electrical Constants of the Soil at Radio Frequency. B. Sen Gupta and S. R. Khastgir. *Phil. Mag.* 22. *pp*. 265–273, *Aug*., 1936.—The electrical conductivity σ and the dielectric constant ϵ of three different specimens of Dacca soil are directly

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determined by a resonance method for various values of moisture content from 0 to 40 % and for varying frequencies from $0{\cdot}135 \times 10^6$ to $2{\cdot}72 \times 10^6 \sim$. The values of σ and ϵ for the specimen of soil taken from a depth of 20 ft. are decidedly lower than those for the surface-soil. Both σ and ϵ are found to increase with the moisture-content, each tending towards a constant value for large values of the moisture-content. The variation of σ and ϵ with frequency is also considerable. Smith-Rose's direct determinations of σ and ϵ with specimens of English soil gave distinctly larger values, whereas Ratcliffe and White's values were of the same order as those obtained by us. The values of the electrical constants of the soil obtained by direct experiments agree in their order of magnitude with the values deduced from the attenuation measurements. [See also Abstract 3434 (1933).] AUTHORS.

See also Abstracts **4090, 4091, 4104, 4105.**

METEOROLOGY.

4097. Heat Exchange within the Trade-Wind Circulation. H. v. Ficker. *Preuss. Akad. Wiss. Berlin, Ber.* 11. *pp.* 103–114, 1936.—The thermodynamics of the heat interchange within the trade-wind circulation is investigated. It is concluded that the inversion is due partly to the adiabatic expansion of air near the zone of calms, and partly to the taking up of water-vapour on the return circulation. W. A. R.

4098. Altitudes from Adiabatic Chart and Refsdal Aerogram. P. J. Kiefer. *Monthly Weather Rev.* 64. *pp.* 69–71, *March*, 1936.—The method of determining the difference in altitude between two points by means of the adiabatic chart is dealt with first. Thereafter the author proceeds to outline the basis of the system of coordinates and the dry-stage lines of the Refsdal aerogram. The properties of the system at (1) constant temperature, (2) constant pressure and (3) joint variation of temperature and pressure, are indicated. In the last case an equation is established which is the same as that obtained by the first method. The author concludes by suggesting that meteorology is in need of a diagram to represent other energy data as linear distances rather than as areas. A. E. M. G.

4099. Erratum in Smithsonian Tables. V. E. Jakl. *Monthly Weather Rev.* 64. *pp.* 84–85, *March*, 1936.—The author deals with an error in the temperature correction contained in the expression for the determination of heights by the barometer. The correct form of the correcting factor is given and the table affected recalculated. The differences between the original and the modified values are shown to be slight. A. E. M. G.

4100. 334-Year Cycle for Meteorological Forecasts. A. Auric. *Comptes Rendus*, 202. *pp.* 2169–2170, *June* 29, 1936.—The author after considering the 334-year cycle from the astronomical point of view, shows that while meteorological phenomena are extremely complicated, yet they are very largely influenced by three periods, annual, lunar, and sunspot. These are all contained in the 334-year cycle. He points out also that this period has advantages over other periods suggested. Thus he concludes that both astronomically and meteorologically the cycle suggested is the best. A. E. M. G.

4101. Sunspots and Weather Forecasting in Canada. A. Thomson. *Roy. Astron. Soc., Canada, J.* 30. *pp.* 215–232, *July–Aug.*, 1936.—In this paper it is first pointed out that the variation in the sunspot fluctuations are so great that it is impossible to forecast the number likely to occur in any given year. Hence it follows that weather forecasting based on sunspot numbers is unreliable. Further the author finds that the variations in the ionisation of the upper layers do not appear to be correlated with the electrical conditions in the troposphere. Again it cannot be demonstrated from the records of precipitation, temperature, etc., taken at stations along the Southern Canadian border extending over a period of from 30 to 80 years, that these elements are affected by sunspots. Likewise in the case of a particular station it is found impossible to use the sunspot period as a basis for forecasting temperature and rainfall. The paper is illustrated by numerous tables and diagrams. A. E. M. G.

4102. Optical Methods of Measuring the Size of Small Water Drops. J. G. Wilson. *Cambridge Phil. Soc., Proc.* **32.** *pp.* **493–498,** *July,* **1936.**—Very small drops are considered such as are found in the form of clouds with a high numerical density of drops. It is shown that the use of the diffraction corona is inapplicable for drops of diameter appreciably less than 50 wave-lengths, and the criterion of Rayleigh scattering shows that the diameters in question are less than the wave-length of light. A third method is discussed for drops of diameter of the order of one wave-length or less; this depends on the colour of the central diffraction maximum for very small drops in Wilson-type fog condensations, the colour of the light scattered through very small angles affording an accurate measure of drop size. The problem is examined mathematically, and intensities are calculated and plotted for a range of drop sizes, and light colours, expansion ratios, and drop radii are tabulated. There appears to be at present no reliable optical method for drop radii between about $1 \cdot 5 \times 10^{-4}$ cm. and the lower limit of corona measurements, about 10^{-3} cm.; the method described also fails below about 5×10^{-5} cm. N. M. B.

4103. Size of Atmospheric Nuclei. H. L. Wright. *Phys. Soc., Proc.* **48.** *pp.* **675–689,** *Sept.* **1, 1936.**—Formulæ are set out for use in determining the size of condensation nuclei from observation of the concentration in the atmosphere of charged and uncharged nuclei and observation of the numbers of small ions of either sign. Ratios of the combination coefficients which specify the ratio of combination of small ions with charged or uncharged nuclei can be deduced from such observations. In the present analysis the following additional principles are assumed: (1) The combination coefficients are related to w, the mobility of small ions by Whipple's hypothetical equation $\eta_{12} - \eta_{10} = 4\pi e w$, and (2) combination between small ions and uncharged nuclei is produced solely by collisions due to the random Brownian movements of the small ions. Assuming that a small ion is equal in mass to eleven molecules of water it is deduced from Scrase's observations at Kew Observatory that so long as the relative humidity is less than 80 % the radius of a nucleus is approximately 3×10^{-6} cm. With higher humidities the radii are larger, at 82 % $4 \cdot 2 \times 10^{-6}$ cm. and at 89 % $4 \cdot 5 \times 10^{-6}$ cm. In the last section of the paper Köhler's theory of the growth of nuclei in an atmosphere in which humidity increases is applied, and on the assumption that the hygroscopic nuclei at Kew are of diluted H_2SO, it is found that in summer the mass of the acid in a nucleus is about 18×10^{-17} gm., the corresponding mass in winter being 12×10^{-17} gm. If the predominant nuclei are of common salt or of nitrous acid these estimates must be halved to give the mass of salt or of the latter acid in a nucleus. AUTHOR.

4104. Height Relations and Mass Content of Greenland Ice Cap. F. Loewe. *Gerland Beitr. z. Geophys.* 48. 1. *pp.* 86–89, 1936.—Sverdrup's equations connecting the ablation of ice on the Isachsen plateau in Spitzbergen with radiation, etc., are inapplicable to the Greenland ice-cap. There is no correlation between accumulation of snow on this ice cap and precipitation on the west coast of Greenland. An error in calculating the height of the ice cap [see Abstract 1567 (1936)] is corrected giving as the height on the west side 2000 m., on the south 1930, and average for the whole 2100 m. C. A. S.

4105. Greenland Ice Cap. F. Loewe. *Roy. Meteorolog. Soc., J.* 62. *pp.* 359–377, *July,* 1936.—Previous to 1930 knowledge of the ice cap had been gained from sledge journeys during the summer only. In 1930–31 the author stayed at the station Mid-Ice, one of the posts of the German Expedition, 250 miles from the edge at an altitude of 10,000 ft. From his experiences there and during sledge journeys he gives a description of the typical weather conditions in different seasons. The annual mean temperature is found to be − 22° F. and the minimum − 85° F. This station is the coldest at which continuous observations have been taken. The prevailing wind on the west side is S.E. or E.S.E., a typical katabatic wind. This arises from a relatively shallow layer of cold air and is the most characteristic climatic feature. The precipitation amounts to about 12 in. per annum. The author considers the results of the expedition as pioneer work, preparing the way for further research. The paper is illustrated by diagrams and photographs. A. E. M. G.

4106. Height and Spectra of the Aurora. L. Harang. *Gerlands. Beitr. z. Geophys.* 48. 1. *pp.* 1–12, 1936.—This paper deals with observations made in Feb., 1934 and Feb., 1936. Variations in the height of the aurora in the border region between the dark and the sunlit portions of the atmosphere were determined by means of parallactic photographs. Alterations in the intensity of the auroral spectra were studied spectrographically. Height measurements and spectral observations were also carried out on red-coloured auroræ. The results show that the under edge is lower when it is coloured red. The red colour is considered to be due to the oxygen atomic lines 6300 and 6360 Å. Records of observations carried out on the night sky are also dealt with. Line diagrams illustrate the paper and several of the auroral and night-sky spectra are reproduced. A. E. M. G.

4107. Visibility of an Object and its Apparent Size. C. S. Karve. *Current Science,* 4. *pp.* 855–857, *June,* 1936.—The objects used in this investigation were white squares, the sides ranging from 2·75 cm. to 33 cm., on a black background 5′ × 4′. The distance of observation ranged from 50 to 180 m. A Wigand step-visibility meter was used. From the results of two sets of observations, one set in the morning, the other in the evening, two curves are drawn, the Wigand number being plotted against the angle subtended in radians. The author concludes from these that (1) 0·5° is a safe lower limit for visibility landmarks, and (2) other conditions being equal, visibility depends on the relative positions of sun, observer and object. A. E. M. G.

4108. Oscillations of the Atmosphere. G. I. Taylor. *Roy. Soc., Proc.* 156*A.* *pp.* 318–326, *Aug.* 17, 1936.—It is shown that when the temperature of the atmosphere is a function only of height above the ground, free oscillations are possible which are identical with those of a sea of uniform depth H, except that the amplitude of the oscillations is a function of the height. The equivalent depth H is related to the velocity V of straight long waves in a non-rotating atmosphere by the relation $V^2 = gH$. There are in general an infinite number of possible velocities V at which long waves can travel. In general, therefore, there is an infinite number of equivalent depths H, but in the special case of convective equilibrium there is only one. The existence of an equivalent depth was conjectured by Laplace, who confirmed his conjecture in the special case of convective equilibrium when $\gamma = 1$. Lamb extended the proof to cover convective equilibrium with other values of V, but no other cases had been solved. Jeffreys and Bartels have given definite integrals for finding this depth, though they have not proved that the atmosphere can oscillate like a sea of uniform depth. Other workers have doubted the existence of an equivalent depth except in the special case mentioned above. It is a corollary to the present work that no integrals of the type proposed by Jeffreys or Bartels can give any of the (in general) infinite number of equivalent depths. AUTHOR.

See also Abstracts **3955, 4388.**

SEISMOLOGY.

4109. Seismic Waves. R. Einaudi. *Accad. Sci. Torino, Atti,* 71. 1. *Disp.2a. pp.* 299–309, *Jan.–April,* 1936.—The first phase of the principal seismic waves can be explained mechanically without recourse to the hypothesis of a lithosphere overlying a fluid magma. W. A. R.

4110. Lunar Triggering Effect on Earthquakes in Southern California. M. W. Allen. *Seismological Soc. of America, Bull.* 26. *pp.* 147–157, *April,* 1936.—Schuster's criterion for the reality of the suspected periodicity mounts constantly with respect to the second harmonic as the body of data grows, whereas with respect to the other harmonics it remains at a low value. In the period of a month or two preceding the stronger shocks the earth stresses are increasing at an accelerating rate, but just before a shock that part of the increment which is applicable to producing rupture is slowed up, presumably because it is used up in producing plastic deformation. The lunar control is more nearly complete for the stronger than the minor earthquakes. W. A. R.

4111. Velocities of P and S Waves Calculated from the Observed Travel Times of the Long Beach Earthquake. C. G. Dahm. *Seismological Soc. of America, Bull.* 26. *pp.* 159–171, *April,* 1936.

4112. Seismic Origins and Radiated Waves. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 149–156, *June,* 1936. *In English.*—The mechanism of seismic origin is of the nature of plastic déformation as the result of a relatively sudden movement mainly due to shearing forces. The radiated waves under these conditions would be mainly distortional. The result is in agreement with Jeffreys' conclusion that P-waves are generated by the reflection of S-waves at discontinuities. W. A. R.

4113. Nature of Transverse Waves Transmitted through a Discontinuity. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 157–163, *June,* 1936. *In English.*—A mathematical solution is obtained for the case of transverse waves with displacements orientated parallel to the plane of the discontinuity layer. W. A. R.

4114. Energy Dissipation in Seismic Vibration of a Structure. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 164–200, *June,* 1936. *In English.*—The authors extend and generalise their previous work [see Abstract 1139 (1936)], and now deal with the following cases of simple structures subjected to incident longitudinal waves; tall structure with rigid floors subjected to incident transverse waves; the same with flexible floors; the general theory of a framed structure; structures of different constructions with fixed and hinged bases; a 7-storied building with rigid floors and fixed base.

W. A. R.

4115. Travel Times in Seismology. H. Jeffreys. *Union Géodésique et Géophysique Internationale, Série A, Travaux Scientifiques, No.* 14. *pp.* 3–86, 1936. *In English.*—The data already given [see Abstract 3388 (1935)] are rediscussed and combined with similar data since available. A systematic method of dealing with the abnormal law of errors that appears to hold in seismology is described, and the standard errors of the resulting tables determined. The method of smoothing is improved. The first results are not greatly altered, but it is now possible to state their degree of accuracy. In particular the discontinuity in the slope of the time curve for P, and the Z phenomenon have been confirmed; and it is shown that there can be no layer of sulphide immediately above the core (unless of negligible thickness), and that the core is continuous in structure all the way to the centre.

C. A. S.

4116. Microseisms. B. Gutenberg. *Seismological Soc. of America, Bull.* 26. *pp.* 111–117, *April*, 1936.—The various suggestions as to the origin of microseisms are discussed, and it is shown that the only probable cause that produces sufficient energy and can be correlated with recorded microseisms is surf on a steep coast, *e.g.*, on the coasts of Norway, Alaska and British Columbia, and of Labrador, for microseisms recorded respectively in N. and W. Europe, at Pasadena and its neighbourhood, and Eastern U.S.A.

C. A. S.

4117. Comparison of Old and New Methods in Analysis of Earthquake of Sept. 9, 1931. A. J. Westland. *Seismological Soc. of America, Bull.* 26. *pp.* 119–124, *April*, 1936.—The reason for the inability to determine satisfactorily the epicentre of certain earthquakes is traced to their foci being at abnormal depths. Such earthquakes are characterised by the insignificance or absence of surface waves, and the appearance of certain new phases, *e.g.*, pP, sP, and sS. Application in such cases of the Brunner depth chart gives a satisfactory solution for the epicentre. This is illustrated by comparing this method with that resulting from the use of normal tables of 1931 to the earthquake of Sept. 9, 1931, at 18° N., 145·5° E.

C. A. S.

See also Abstract 4093.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4118. Movements of Electrically Charged Cloud Particles. J. P. Gott. *Cambridge Phil. Soc., Proc.* 32. *pp.* 486–492, *July*, 1936.—Experiments are described in which observations were made of the motion of electrically charged cloud particles past a sphere. The cloud particles were moving vertically in an air stream, and there was a vertical electric field. This gave conditions similar to those surrounding a falling rain drop in a thundercloud, and the observations are in accordance with the theory proposed by Wilson to account for the mechanism of thunderclouds.

AUTHOR.

See also Abstracts 4103, 4106.

RADIOACTIVITY.

4119. Chemical Reactions Produced by Ionisation Processes. Part I. Ortho-Para Hydrogen Conversion by α-Particles. H. Eyring, J. O. Hirschfelder and H. S. Taylor. *J. Chem. Phys.* 4. *pp.* 479–491, *Aug.*, 1936.—The possible individual processes that may occur in a gaseous system under irradiation from α-particles are examined from the theoretical standpoint. The ionisation, clustering and the fate of the ions are studied. The ortho-para hydrogen conversion under the influence of α-particles is chosen as an example with which to illustrate the method of treatment. Recent experimental data by Capron are analysed to confirm his conclusion that atomic hydrogen is responsible for the large ratio of molecules converted to ions produced (M/N = (700 to 1000)/1). It is also shown that clustering is unimportant in this case and that the paramagnetism of the ions is of negligible importance in producing the spin-isomerisation. The rôle of mercury atoms in removing atomic hydrogen from the system is found to be negligible. Removal of atoms by 3-body collision of two atoms with molecular hydrogen is slow compared with removal at the walls of the reaction vessel. Analysis of this latter process shows excellent agreement with the experimental data on the conversion efficiency of the system. AUTHORS.

4120. Materialisation of Energy of β-Rays from Ra-C. A. M. da Silva. *Comptes Rendus*, 202. *pp.* 2070–2072, *June* 22, 1936.—The number of positrons resulting from the materialisation of β-rays from $RaBr_2$ in Pb or Al (allowance being made for positrons emitted by the source) is determined by means of an arrangement very similar to that described [see Abstract 1252 (1935)]. The results (shown by curves) indicate a maximum for a thickness of Pb equivalent to 10 gm./cm^2., and an efficacious cross-section of the Pb atom of 8×10^{-23} cm^2. Approximately the same number of positrons are produced with a screen of Al of equal superficial mass, which indicates the probability that materialisation is proportional to Z, rather than to Z^2 as required by present theory.

C. A. S.

4121. Continuous β-Ray Spectrum of Radium E. M. Lecoin. *Comptes Rendus*, 203. *pp.* 171–173, *July* 15, 1936.—By the same method [see Abstract 4440 (1933)] the β-ray spectrum of Ra-E was determined with special attention to the portion below 500 eV. Results (shown by a curve) differ distinctly from those obtained by the method of coincidences [see Abstract 4193 (1935)], as also does the average energy ($2 \cdot 5 \times 10^5$ eV) from a previous result [see Abstract 664 (1928)]. C. A. S.

4122. Cloud Chamber Experiments with γ-Rays and β-Rays in Xenon and Krypton. H. Klarmann and W. Bothe. *Zeits. f. Physik*, 101. 7–8. *pp.* 489–498, 1936.—Using an expansion chamber, which has already been described [see Abstract 3228 (1935)], the formation of electron pairs by the passage of filtered γ-rays from Th C″ in Xe and Kr, is examined. The angular separation of the components of the pair increases with the atomic number. Single scattering of β-particles of energies between 0·5 and 2·4 eMV by Xe and Kr nuclei was found to occur with considerably less frequency than that predicted by quantum mechanical theory for elastic collisions. A considerable proportion of the collisions was accompanied by a large loss of energy; in general this was not associated with the creation of electromagnetic radiation, and it is suggested that some other process such as the creation of neutrinos is involved. F. C. C.

4123. β-Rays and γ-Rays of the Actinium Family. J. Surugue. *J. de Physique et le Radium*, 7. *pp.* 337–346, *Aug.*, 1936.—Continuing previous work [see Abstract 1582 (1936)] the characteristic β- and γ-rays from RaAc, AcX, actinon and its active deposit are examined. Using Sève's induction method, the standard absolute value for the most intense line is $H\rho = 1946$. More than 50 new β-rays are recorded for RaAc and AcX; 23 γ-rays are found from RaAc although only 10 were reported by Hahn and Meitner. A scheme of energy levels is constructed from these γ-ray energies analogous to that constructed from the fine structure of the α-rays. The nuclear level system obtained for AcX with the aid of 14 γ-rays (only 5 of which were recorded by Hahn and Meitner) is in excellent agreement with that given by α-ray data. Eight γ-rays are recorded from actinon. F. C. C.

***4124. Dependence of Ionisation Current upon Dimensions of Small Closed Chambers. E. Miehlnickel and H. Osterwisch.** *Zeits. f. Physik*, 101. 5–6. *pp.* 352–371, 1936.—The dependence of ionisation current upon chamber volume is measured for 6 closed spherical chambers made of "air-equivalent" material (97 % C + 3 % Si). The thickness of the walls is 0·4 mm. and the internal diameters from 4 to 20 mm. Departure from direct proportionality to volume is observed, the sense being the same as for the same chambers in the X-ray region. These deviations can be explained qualitatively on the basis of the theory of the action of the chambers previously put forward for X-rays [see Abstract 5100 (1934)]. L. A. W.

***4125. Emanation Electroscope. B. A. Spicer.** *Journ. Sci. Instruments*, 13. *pp.* 263–267, *Aug.*, 1936.—An instrument is described for the estimation of quantities of Rn in the range of activities not covered by the existing emanation or γ-ray electroscopes. The sensitivity is controlled by a variable capacity. AUTHOR.

See also Abstracts 3915, 3917, 3918, 3929, 4011, 4012, 4094, 4095, 4137, 4163, 4164.

RADIATION.

ABSORPTION AND TRANSMISSION.

4126. Validity of the Lambert-Beer Law in Light Transmission through Hydrophobic Colloids. F. B. Gribnau, H. R. Kruyt and L. S. Ornstein. *Kolloid Zeits.* 75. *pp.* 262–268, *June,* 1936.—From measurements of the extinction coefficient of light by various colloid suspensions in different concentrations it is concluded that the Lambert-Beer law is valid for hydrophobic colloids, provided that there is no appreciable scattering and that chemical changes are not produced during the experiment. A. C. M.

4127. Optical Constants of Copper-Nickel Alloys. N. F. Mott. *Phil. Mag.* 22. *pp.* 287–290, *Aug.,* 1936.—The anomalous behaviour of the absorption coefficient of Cu-Ni alloys for light of 5780 Å. [see Abstract 3863 (1935)] which rises quickly with composition up to 40% Ni, and then flattens out, is explained in terms of the electron theory of metals. The theoretical meaning of the composition $Cu_{60}Ni_{40}$, which also forms the boundary between ferromagnetic and paramagnetic alloys [see Abstract 3139 (1935)], is that the 3*d* level of the atom is completely filled in the alloys below 40 % as in Cu, while with more Ni the number of electrons in this level diminishes. A formula is given for the long-wave limit of the absorption band as a function of composition. R. P.

***4128. Christiansen Filters. G. Ahier.** *Comptes Rendus,* 202. *pp.* 1775–1777, *May* 25, 1936.—Improved filters, using inorganic solutions instead of organic liquids, are described and transmission data recorded. W. R. A.

See also Abstracts 3973, 4148, 4176, 4410, 4411.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4129. Thermal Variation of the Magnetic Birefringence of Nitric Oxide and of Compressed Oxygen. H. Bizette and B. Tsaï. *Comptes Rendus,* 202. *pp.* 2143–2145, *June* 29, 1936.—The variation of the magnetic birefringence of NO, previously investigated at ordinary temperature [see Abstract 157 (1936)], is studied over the temperature range 20° to − 80°, at constant volume, and also at constant pressure. In each case there is no appreciable variation. This unexpected result is explained by a compensation of the effects due to the different types of molecules. The magnetic birefringence of O_2 under the same conditions increases according to a law intermediate between the inverse square and inverse cube of the absolute temperature. H_2 at 110 kg./cm². shows no appreciable birefringence in the same temperature range. Values of the Cotton-Mouton constant are determined as follows: NO, 355×10^{-15} at 19° and 100 kg./cm².; CO_2, $-5\cdot3 \times 10^{-14}$, SO_2, $2\cdot5 \times 10^{-14}$, at 0°. N. M. B.

4130. Faraday Effect of Strong Electrolytes in Aqueous Solutions. Part IV. Lithium Bromide, Sodium Bromide and Potassium Bromide. A. Okazaki. *Ryojun Coll. Eng., Mem.* 9. *pp.* 13–27, *March,* 1936.—The relation between the magneto-optical rotation and the concentration of aqueous solutions of LiBr, NaBr and KBr is investigated for D-lines. It is found that the " corrected " molecular rotation $M[D_2]$ of these salts decreases with increasing concentration as their molecular refractivities R_2. On the assumption that these salts in solution have only one absorption band, the decrease of $M[D_2]$ with increasing concentration is found to be attributed to the existence of undissociated molecules in concentrated solution as in the case of R_2. The value of $M[D_2]$ in the completely dissociated state has been determined by graphical extrapolation to infinite dilution. Using this value and the corresponding one of R_2, two dispersion constants, that is, the number of dispersion electrons in the molecule and the value of the absorption band of these salts in completely dissociated state are calculated. [See also Abstract **2503** (**1935**).] AUTHOR.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4131. Photoluminescence of Feldspar. S. Iimori. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 632. *pp.* 79–110, *June*, 1936. *In English.*—Observations are given which support the theory of photolumino-transformation [see Abstract **3793** (**1931**)] and the hypothesis presuming the existence of two kinds of centre, temporary and permanent. The mineral was a perthite whose composition may be expressed as $(K^{11} Na)_2 O. Al_2O_3. 6SiO_2$. Curves are given showing the growth of luminescence with time of exposure to the exciting light both for the untouched mineral and for samples in which the natural thermoluminescence has been driven off either by heating or by exposure to suitable rays. The latter is regarded as showing the luminescence due to induced temporary centres only. The decay curves all appear to be simple exponential. The author supposes that in any naturally luminescent mineral the permanent centres (produced by terrestrial rays) are excited to phosphorescence by suitable radiant energy and that at the same time temporary centres are formed if the energy quantum is bigger than the heat of formation of the base material. The amount of such temporary centres grows with time of excitation to an equilibrium value which depends on their rate of decay. It is shown that the theory leads to the expression for the photographic blackening given by the phosphorescent light

$$D = \sum_{n,l,m.} A_n(e^{-\lambda_l\theta} - e^{-\lambda_m\theta}) + \sum_{n,p} B_n\,(1 - e^{-\lambda_p\theta})$$

where the first term represents the permanent centres and the second term the temporary centres and θ = time of exposure. This has been found to accord with the experimental results. In a purely theoretical Appendix the author objects to the crystal structure theory of luminescence and restates his hypothesis that the centres consist of pairs of colloidal particles of a number of atoms of base metal and impurity metal paired with colloidal particles of acidic element of base material formed in the interspaces between the crystal mosaics by the exciting energy. It is considered that bases suitable for phosphors are those in which the heat of dissociation is lower than the centre forming excitation energy. The fact that the heat of formation of the alkali sulphides which are excited by visible light corresponds to u.v. light quanta is explained by supposing that there is heat of association which brings down the heat of dissociation to a value corresponding to quanta of visible light. The function of the activating impurity metal is regarded as an aid to the formation of mosaics, the liberated atoms of the base associating round the impurity atoms. Similarity of atomic radii of base metal and impurity metal is considered a criterion for the activating metal. Luminescence is regarded as a flame occurring in the interspaces by the direct combination of the metal with the oxygen or sulphur. Phosphorescence is explained as a kind of chain reaction. J. E.

4132. Polarised Fluorescence of Organic Dyestuff Solutions. L. Grisebach. *Zeits. f. Physik*, 101. 1–2. *pp.* 13–22, 1936.—The degree of polarisation of four dyestuffs in glycerin solution was determined as a function of the wave-length of exciting linearly polarised light. A connection was found between this function and the absorption spectrum of a given solution. The fact that uranine excited by elliptically polarised light shows no elliptical polarisation in its fluorescence is taken as indicating that the emitting oscillator is anisotropic. J. E.

***4133. Fluorescence of Solutions. A. Boutaric and J. Bouchard.** *Comptes Rendus*, 203. *pp.* 167–169, *July* 15, 1936.—A fluorometer, similar to that of Perrin, is described, the whole of the optical parts being of quartz. The variation with concentration of the fluorescence produced by u.v. radiation for solutions of substances such as sulphate of quinine and esculine is studied. A. H.

See also Abstract 4196.

INTERFERENCE. DIFFRACTION AND SCATTERING.

***4134. Wave-Length Measurement with a Divergent Beam and a Plane Grating. D. L. Das.** *Zeits. f. Physik*, 101. 7–8. *pp.* 447–455, 1936.—Divergent light from a slit passes a ruled grating normally. The diffracted images of the slit then are displaced sideways and in addition have a smaller distance from the grating than the slit itself. This distance can be measured by focusing a microscope on to the diffracted image. It can be used to adjust the position of the grating, for if the grating is tilted with respect to the beam the diffracted images on left and right will have different distances. A mathematical theory of the method and a simple experimental verification using Na light are given. R. P.

4135. Longitudinal Plotnikow Light Scattering. V. S. Vrkljan. *Acta Physica Polonica*, 4. 3. *pp.* 325–330, 1935. *In German.*—Vrkljan comments on a paper by B. Čoban [see Abstract **4966** (1935)] dealing with longitudinal light-scattering ("Plotnikow effect") observed in aliphatic compounds and in starch solutions, and suggests that (1) the observations do not necessitate a new effect, but can be explained on existing theories of light scattered by turbid media, and (2) that the experiments themselves are open to criticism on the grounds of purity of substances used, and opportunity for dust to fall in the experimental tank. In a reply **L. Šplait** asks Vrkljan to answer five questions and by implication suggests that the results so far obtained are inexplicable on the basis of existing theories. A. C. M.

4136. Doppler Effect in Light Scattering in Liquids. Part III. Polarisation of Light Transversely Scattered by Formic and Acetic Acids. B. V. R. Rao. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 607–609, *June*, 1936.—The present work deals with the study of the state of polarisation of the three components observed in the spectrum of monochromatic light scattered by liquid formic and acetic acids, when examined with a Fabry-Perot etalon. It is noticed with these liquids that the central undisplaced component of the triplet observed on analysing the transversely scattered light spectrographically with a Fabry-Perot etalon shows an appreciable degree of depolarisation, differing in this respect from non-associated liquids like CCl_4, toluene and CS_2, in which the central component is unobservable in the horizontal vibration of the transversely scattered light. There is thus an indication of the presence of large non-rotating or immobile clusters of molecules in these liquids which depolarise the scattered light. [For Part II see Abstract 4967 (1935).] AUTHOR.

4137. Scattering of Light by Light. H. Euler. *Ann. d. Physik*, 26. 5. *pp.* 398–448, *July*, 1936.—According to Dirac's theory, it should be possible for the interaction of two light quanta to produce two others. The paper consists of a mathematical discussion of this possibility in general terms, and some special cases are calculated. It is found that the "effective radius" for this scattering is of the order of 10^{-15} cm. for γ-rays, 10^{-24} cm. for X-rays, and 10^{-36} cm. for visible light, so that an experimental verification would be exceedingly difficult. A. C. M.

***4138. Sputtering of Large-Aperture Fabry-Perot Interferometer Mirrors. S. Tolansky and E. Lee.** *Journ. Sci. Instruments*, 13. *pp.* 261–263, *Aug.*, 1936.—A method of producing large-aperture Fabry-Perot interferometer mirrors by sputtering silver in argon is described. Local variations of film thickness can arise from shadow effects due to the electrode supports, and these are eliminated. A trap cooled by liquid air assists the production of good mirrors, and by reducing the sputtering time diminishes unwanted effects due to heating. AUTHORS.

See also Abstracts 4102, 4142, 4152, 4296, 4297.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4139. Electronic State of the Radicals in Polyatomic Molecules. V. Henri. *Comptes Rendus*, 203. *pp.* 67–69, *July* 6, 1936.—The author has previously shown [see Abstract 5047 (1934)] that the carbonyl group of aldehydes and ketones, and of their halogenated derivatives is found in these molecules in the active state corresponding to the state *a* ($^3\Pi$) of the molecule CO. The criteria employed for the determination of the electronic state of the different radicals in the molecules are: The characteristic vibration frequency of these radicals in the Raman spectra and the infra-red, and the determination of atomic distances in the radicals as measured by X-ray diffraction and electronic rays. In this paper the following radicals are investigated by the above method: SO, CN, C=C, NN, and NO. In each case data are given for the vibration frequency and atomic distances in the free state and in combination, and should serve as a basis for the analysis of the mechanism of chemical reactions and for a new interpretation of the laws of chemical kinetics. H. H. Ho.

4140. Kinetics of Recombination of Iodine Atoms. E. Rabinowitch and W. C. Wood. *J. Chem. Phys.* 4. *pp.* 497–504, *Aug.*, 1936.—The equilibrium $I_2 + h\nu \rightarrow I + I$; $I + I \rightarrow I_2$, was studied in presence of different foreign gases by means of a sensitive optical arrangement [see Abstract 2060 (1935)]. This equilibrium is found to be a heterogeneous one at low pressure, the atoms recombining mainly by diffusing to the walls. In this region, the dissociation increases with rising pressure. At a higher pressure (of about 250 mm. in He, 40 mm. in CO_2, etc.), the recombination becomes homogeneous. The transition is sharp, and practically no influence of the walls is observed at pressures above the transition point. In the region of homogeneous recombination, the dissociation is exactly proportional to the square root of light intensity and to the inverse square root of pressure, in accordance with the theoretical formulæ for the "recombination by three-body collisions," $I + I + X \rightarrow I_2 + X$. The velocity constants of these reactions are calculated for different gases X, and the order of increasing efficiency in promoting recombination is He, A, H_2, N_2, O_2, CH_4, CO_2, C_6H_6. One double collision $I + I$ in 530 is a recombining one in helium, and one in 50 in carbon dioxide at atmospheric pressure. The efficiency as third body is higher for the di- and polyatomic molecules than for the monoatomic ones, and increases with growing molecular size and the intensity of the molecular fields of the colliding particles. H. H. Ho.

***4141. Reproduction of Photographic Graininess. L. S. Ornstein and A. van Kreveld.** *Physica*, 3. *pp.* 815–822, *Aug.*, 1936. *In English.*—A statistical theory is given of the connection of the graininess of the photographic negative and the fluctuations of the density measured with an arrangement containing a galvanometer. This theory is applied to the microphotometer and the graininess-meter. AUTHORS.

***4142. Resolving Power of Sensitive Photographic Materials. R. Bruscaglioni.** *Accad. Lincei, Atti*, 23. *pp.* 686–689, *May* 3, 1936.—Hitherto a photographic method has been used in researches on the resolving power of sensitive photographic materials and in this there have been many difficulties. A new method is described which depends on interference measurements by means of an interferometer which is a modification of that of Young. In this a more easy determination of the point of convergence of the fringes is obtained and thus a better method of finding the resolving power of the emulsified surfaces. J. J. S.

4143. Spectral Transmission of Developed Photographic Emulsions. M. Roulleau. *Comptes Rendus*, 202. *pp.* 2066–2067, *June* 22, 1936.—It is found that the neutrality of tint of developed photographic emulsions varies little with the developer used. Those containing genol tend to give the best degree of neutrality, and slow plates are more neutral than fast ones. Transmission figures are given for a process plate showing a higher degree of neutrality between 8650 and 3650 Å than the best neutral tint glasses. It is shown that suppression of the u.v. transmission band of Ag by treatment with mercuric chloride does not affect the general neutrality of the emulsion. D. H. F.

4144. Positive Photographic Emulsions. A. Charriou and Suzanne Valette. *Phot. J.* 76. *pp.* 407–410, *July*, 1936.—Describes the methods of making several positive photographic emulsions, briefly stating the photographic properties of each emulsion. For black tones positive AgBr, Ag iodo-bromide and Ag iodo-chloro-bromide emulsions can be used, two methods of preparing the last two types and of preparing slow positive chloro-bromide emulsions used for warm tones being given. R. C. F.

***4145. Recording Physical Densitometer. C. Tuttle.** *Kodak Research Lab., Comm. No.* 587. *J.O.S.A.* 26. *pp.* 282–292, *July*, 1936.—After indicating 4 possible methods of controlling the recording stylus in a densitometer, the advantages and disadvantages of each are discussed and the construction of the instrument is given in detail. The method chosen for stylus control is one in which equality of intensity of two beams is indicated by equality of two photo-cells, one in each beam, the light falling on the measuring cell being controlled by a variable diaphragm before passing through the sensitometric strip. The cells are connected in opposition to a galvanometer so that when they are illuminated to the same level, the deflection is zero and a tripping cell is operated which stops the movement of the diaphragm and discharges a spark from the stylus through the recording paper. Details of the optical circuit, the galvanometer and cell circuit, and the relay are discussed, and, finally, the permance of the instrument and the variables which influence the performance are dealt with. R. C. F.

4146. Weigert's Phenomenon. H. Freundlich. *Phot. J.* 76. *pp.* 395–404; *Disc.*, 404–406, *July*, 1936.—Deals with the importance of this phenomenon in photography, after giving simple conceptions of dichrosim and double refraction. Weigert found that light can act as an external orientating force upon colloidal systems, and his original discovery, using photochlorides, is briefly described. Kuhn's discovery that an aqueous gel of cotton yellow shows photoanisotropy is discussed, and the photoanisotropic behaviour of photohalides is dealt with in more detail. Light of long wave-length produces marked primary photodichroism except at very low temperatures, AgCl and Ag are essential for the phenomenon, but not gelatin, and the total amount of metallic silver does not change on formation of the dichroic spot. Finally, developable photoanisotropy, discovered by Weigert, and the action of circularly polarised light are considered. R. C. F.

See also Abstracts 4131, 4417.

PHOTOMETRY.

***4147. Improved Hartmann Microphotometer. H. Lorenz.** *Zeits. f. Instrumentenk.* 56. *pp.* 294–298, *July*, 1936.—Describes improved forms of the Hartmann visual microphotometer. The improvements consist in constructional modifications designed to secure robustness, greater facility in the manipulation of the plate being examined, and finer control of the neutral wedge. It is estimated that the accuracy attainable by a trained observer using the present instrument is about 0·01 stellar magnitude. J. W. T. W.

***4148. Colour Filters for Altering Colour Temperature. R. S. Estey.** *J.O.S.A.* 26. *pp.* 293–297, *July*, 1936.—A study of the problem of altering the colour temperature of the light given by a source by interposing a colour filter, either liquid, gelatin or glass. It is proposed to rate such filters in micro-reciprocal degrees (mireds) expressing the quantity $(1/T_2 - 1/T_1)$ where T_1 is the original colour temperature and T_2 the colour temperature after passing through the filter. The Wratten photometric filters, the Davis-Gibson liquid filters and various glass filters are rated, and their different characteristics are given. J. W. T. W.

4149. Photometry of Metal-Vapour Lamps. G. Heller. *Philips Techn. Rev.* 1. *pp.* 120–125, *April*, 1936.—Following a discussion of the principles of photometry with regard to coloured light sources, an arrangement is described by means of which the luminous flux of gas-discharge lamps is measured. Some results obtained in the photometric investigation of sodium-vapour and mercury-vapour lamps with this apparatus are discussed in detail. The fundamental difficulties in the photometry of light-sources whose spectral intensity distribution does not correspond to that obtained with the standard, appear to be particularly pronounced in measurements on the mercury-vapour lamp. In conclusion, investigations are discussed which are being made in order to overcome the difficulties of heterochromatic photometry. AUTHOR.

4150. Physical Photometry of Gas-Discharge Tubes. M. Laporte and F. Gans. *Comptes Rendus*, 203. *pp.* 62–63, *July* 6, 1936.—Allowance is made for the variation in sensitivity of the eye with wave-length by dispersing the radiation and placing in the plane of the spectrum a diaphragm whose dimension at each wave-length in the direction parallel to the spectrum lines is proportional to the ordinate of the visibility curve of the eye at that wave-length. The radiation is then condensed on to a thermopile, whose indications of the relative intensities of different gas tubes are then found to agree closely with visual determinations. D. H. F.

***4151. Objective Photometer with Logarithmic Scale. L. Keidel.** *Die Kinotechnik.* 18. 10. 1936.—An amplifier, of which the output is proportional to the logarithm of the input is described and is used in conjunction with suitable photo-cells to provide an objective photometer. To obtain the logarithmic scale the input to the amplifier is *via* a fluid potentiometer. An electrode moves in the fluid and the potential it picks up is fed to the input of the amplifier. The electrode is attached to the needle of a milliammeter which is connected to the output of the amplifier. Any increase in the amplifier output results in the input being reduced by the potentiometer. In this way a logarithmic scale is obtained on a meter attached to the output terminals of the amplifier over a range of $10^4:1$ in input volts. To use the amplifier in conjunction with a photo-cell the light falling on the cell is modulated by interrupting it with a trembler. Curves obtained using a number of cells are shown. K. M. C.

See also Abstracts 4049, 4141, 4153, 4237.

POLARISATION.

4152. Dispersion of Depolarisation of Rayleigh Scattering. Part I. Fatty Acids. R. S. Krishnan. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 566–571, *June*, 1936.—The paper describes the results of measurements on the dispersion of polarisation of light scattered by benzene, formic acid, acetic acid, propionic acid and isobutyric acid. The depolarisation factor for benzene is constant over a wide range of wave-length. In the case of formic acid and propionic acid the depolarisation factor is found to increase and in acetic acid it is found to decrease towards the ultra-violet. It is pointed out that the formation of large molecular groups in the fatty acids is probably responsible for the observed dispersion of depolarisation. AUTHOR.

***4153. Photographic Photometry of Plane Polarised Light with Prism Spectrographs. G. Bolla.** *N. Cimento*, 13. *pp.* 145–163, *April*, 1936.—Owing to the polarising action of the prism spectrograph and the photographic plate, it is necessary in the spectrophotometry of polarised or partially polarised light sources to adopt special methods. If similar but distinct images of the light source, polarised respectively parallel and at right angles to the entrance slit of the spectrograph, are focussed on the entrance slit by interposing a double refracting prism, the two spectrographic tracts so obtained enable the relative intensity of the components of the original radiation to be determined provided the effective transmission factors of the spectrograph and photographic plate for the two directions of polarisation are known. Methods for determining these transmission factors (or strictly their ratio) are described. Several optical devices which make the actual determination of these factors unnecessary are also mentioned. The paper deals solely with spectrographs employing glass lenses and prisms. W. S. S.

See also Abstracts 4132, 4136, 4226, 4227.

RADIATION, EMISSION.

***4154. Radiation Measurements with the Gas Radiometer. M. Plotnikow, Jr.** *Acta Physica Polonica,* 4. 3. *pp.* 195–204, 1935. *In German.*—Describes a modification of the method previously reported [see Abstract 1127 (1934)]. The quartz plate absorbs in the infra-red from 4μ onwards so this has been replaced by an artificially prepared plate of KCl. The method used for making plates of this material, up to about 8 cm. dia., is described in detail. The substitution of KCl for quartz gives a larger figure for the transformation coefficient (1·43 % as against 1 %), since all wave-lengths as far as 24 μ are now included. A still higher sensitivity may be obtained by using Pt gauze or graphite sheet in place of platinum foil. The apparatus will detect the heat radiated from the hand. J. W. T. W.

***4155. Sensitivity of the "Double-Film" Radiometer. M. L. Weingeroff.** *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 580–587, 1936. *In German.*—This radiometer consists of a film of quartz, 1 μ thick, on which a metal film of the same thickness has been deposited, mounted *in vacuo.* On irradiation the composite film becomes curved, and the radius of curvature is a measure of the intensity of the radiation. The sensitivity of this arrangement is calculated. It is shown that the sensitivity is increased if a part only of the surface is blackened, the remainder being left strongly reflecting, and the radiation concentrated on to this blackened part. D. H. F.

4156. Bose's Quantum Statistics Applied to Planck's Formula for Thermal Radiation. V. Karapetoff. *Mechanical Engineering,* 58. *pp.* 490–504, *Aug.,* 1936.—A detailed review is given of the mathematical methods employed and Planck's formula is deduced using Bose's statistical method.

***4157. Emissivities of Solids and Powders. B. Alexandrov and A. Courtener.** *Techn. Phys., U.S.S.R.* 3. 5. *pp.* 465–475, 1936. *In French.*—The theory underlying emissivity measurements is set out and a suitable thermopile and technique described. This is applied to determine the emissivities of several materials. Most powders approximate to black bodies, but powdered NaCl has a lower emissivity. It is considered that the chief source of error in previous determinations has been in the measurement of the surface temperature. A method involving the use of two thermopiles is proposed which renders it no longer necessary for this to be known. R. W. P.

4158. Cosmic-Ray Showers. Y. Watase and S. Kikuchi. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 210–224, *May,* 1936. *In English.*—The rate of production of showers is measured with sheets of Pb above the counters, the thickness, separation and distance of the sheets from the counters being varied. The results are rather in favour of the view that the shower particles are softer than the shower-producing radiation. This conclusion does not accord, however, with the results of further measurements, in which a low value is found for the absorption coefficient of the shower particles, by observing the variation of coincidence-frequency when different thicknesses of Pb are introduced between the upper and lower counters in the shower-counting assembly. Further experiments show that the curve connecting shower-frequency and Pb-thickness near the origin is linear when the Pb sheet is large, but is curved when the Pb and counters are so disposed that a ray originating in the Pb can pass through only one counter. The authors consider this to be unfavourable to Geiger and Fünfer's analysis of cosmic radiation and its secondaries into five types [see Abstract 1599 (1935)]. Under thicknesses of water varying between 50 and 200 cm. the shape of the curve connecting shower-frequency and Pb-thickness is found to be constant. It is also found that the rate of shower production falls off rather more quickly than does the vertical intensity of the general cosmic radiation as the thickness of the water layer increases. D. H. F.

4159. Divergence of Cosmic-Ray Shower Particles. P. Auger and (Mme.) Grivet-Meyer. *Comptes Rendus,* 203. *pp.* 246–248, *July* 20, 1936.—Results are given showing how the counting rate of a shower-counting assembly diminishes as the distance from the source of showers (*e.g.*, a Pb screen) increases, on account of the divergence of the particles. It is shown how use can be made of this effect to separate the shower-producing and the radiation-absorbing actions of Pb. D. H. F.

4160. Soft Primary Corpuscular Radiation as a Shower Producer. J. Clay and A. van Gemert. *Physica,* 3. *pp.* 763–768, *Aug.,* 1936. *In English.*—Soft primaries can produce showers directly or through an intermediate (photon) radiation. Observations of showers with different geometrical arrangements of the material show that the soft radiation produces showers in lead directly, in this sense, that if there are intermediate photons at all these must have a very short range. Evidence from various sources shows that the slope on the right hand side of the first shower maximum gives the decrease of the soft primary radiation. AUTHOR.

4161. Galactic Rotation and Cosmic Rays. L. A. van Wijk. *Physica,* 3. *pp.* 769–774, *Aug.,* 1936. *In English.*—The influence of galactic rotation according to Compton and Getting [see Abstract 3010 (1935)] is discussed for rays in a vertical system of counters at the earth's magnetic equator. For an exponential energy distribution according to Clay : $e^{-V/(3\times10^{10})}$, the diurnal effect, is found to be at least 0·25 %. AUTHOR.

4162. Dutch Cosmic-Ray Expedition, Amsterdam—Panama—Chile. J. Clay, E. M. Bruins and J. T. Wiersma. *Physica,* 3. *pp.* 746–756, *Aug.,* 1936. *In English.*—The present paper is a report of cosmic-ray measurements taken on a voyage from Amsterdam via Panama to Corral (Chile) and back on board the "Boskoop" of "the Royal Netherlands Steamship Company," June—Oct. 1935. The latitude effect was measured and the longitudinal effect could be estimated very satisfactorily on the way from Amsterdam to Panama. The hardening of the rays with decreasing latitude was measured with different counters for layers of lead. Near Valparaiso asymmetry effects were measured for two different angles under normal conditions of absorption. Especially the influence of earth magnetic irregularities on cosmic rays was tested, and it is concluded that Peru is the most disturbed region of the earth hitherto found. AUTHORS.

***4163. Results of the Dutch Cosmic-Ray Expedition 1933. Part VIII. Ionisation-Balance in the Atmosphere. M. R. van der Loeff.** *Physica*, 3. *pp*. 775–780, *Aug*., 1936. *In English*.—A new balance is given for the ionisation in the atmosphere, in which the influence of the big ions in the measurements of the recombination of the ions according to Schweidler's " Method II " as well as in the measurements in the Ebert-aspirator is accounted for. AUTHOR.

***4164. Results of the Dutch Cosmic-Ray Expedition 1933. Part IX. Ionisation-Balance for Cosmic Rays on the Ocean. J. Clay and M. R. van der Loeff.** *Physica*, 3. *pp*. 781–796, *Aug*., 1936. *In English*.—The results are given of the measurements of the number and the average life of ions, and of the number of charged and uncharged condensation-nuclei in the air on the open sea. The number of fast ions was constantly recorded with the aid of an Ebert-aspirator combined with an electrometer-triode. The diurnal variation in Bandoeng, the influence of approach to the coast, of fog and of rain and the mobility-spectrum were investigated. The average of all the measurements of ions caught in the aspirator was 213 ions per cc. of air. Following Schweidler's " Method II " the " half-value voltage " was determined; as an average $H = 0 \cdot 80$ V, corresponding to an average life $\delta = 63$ sec. Calculation of the ionisation on the ocean from the balance [see preceding Abstract] gives as an average $q = 2 \cdot 0\ J$, in sufficient agreement with the value q between $1 \cdot 8$ and $2 \cdot 1\ J$, due to cosmic radiation only. AUTHORS.

4165. Sidereal Time Variation of Cosmic-Ray Intensity. A. Ehmert. *Zeits. f. Physik*, 101. 3–4. *pp*. 260–269, 1936.—Extended measurements of the diurnal variations of the intensity of vertically incident cosmic rays showed that four maxima of intensity occurred each day. The times at which the maxima occurred varied from day to day, but showed a correlation with the barometric pressure. When reduced to a constant pressure and expressed in sidereal time, the times of the maxima agree from day to day and are equally spaced at 6 hour intervals. The effect of decreased atmospheric pressure is to displace the maxima to later times. A theory of this displacement in terms of the bending of the primary rays in the earth's magnetic field is outlined and leads to the conclusion that the primary rays are negatively charged particles. W. S. S.

4166. Asymmetry of Angular Distribution of Cosmic Radiation. W. Kolhörster and L. Jánossy. *Zeits. f. Physik*, 101. 7–8. *pp*. 418–421, 1936.—Observations are reported showing systematic differences over a long period between the east and west intensities, and between the north and south intensities. These asymmetries are shown to be consistent with the hypothesis that the cosmic radiation originates from isolated sources. D. H. F.

4167. Cosmic Radiation and Speed of Certain Chemical Reactions. J. Reboul. *Comptes Rendus*, 203. *pp*. 245–246, *July* 20, 1936. —The formation of oxygenated water from damp air in the presence of Zn, Mg or Cd, as shown by the action on a photographic plate when a sheet of the metal is placed nearly in contact with it, was found to be slightly less inside a heavy Pb shield than outside, and slightly more at the top of a 20-m. tower than in a cellar. This is regarded as evidence that the chemical action is influenced by cosmic radiation, which, it is suggested, excites from the metal a highly absorbable secondary radiation which directly influences the reaction. D. H. F.

See also Abstracts **4094, 4316, 4421.**

RADIATION, GENERAL THEORY.

4168. Neutrino Theory of Light. D. Iwanenko and A. Sokolow. *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 692–695, 1936. *In German.*—This is a theoretical paper in which the relationship of the nucleus-neutrinos to light-neutrinos is investigated mathematically. D. H. F.

See also Abstracts **4033, 4137.**

RADIATION, MECHANICAL EFFECTS.

4169. Radiation Pressure and Brownian Motion. M. Satô. *Tohoku Univ., Sci. Reports,* 25. *pp.* 156–162, *April,* 1936. *In German.*—By applying the classical law of conservation of momentum it is shown how to deduce the law of radiation pressure and the theory of Brownian motion from Planck's law of radiation. G. C. McV.

See also Abstract **4082.**

REFLECTION. REFRACTION AND DISPERSION.

4170. Microscopic Comparison of Reflecting Powers. L. Capdecomme. *Comptes Rendus,* 202. *pp.* 2061–2064, *June* 22, 1936.—A discussion is given of the errors which arise, in the usual methods, from failure to place the specimens under comparison in exactly the same position relative to the microscope (*e.g.*, on account of the depth of the focus of the instrument), and from inclination of the surfaces to the optical axis. Methods of reducing these errors are described. D. H. F.

4171. Measurements of Birefringence in the Ultra-Violet. R. Servant. *Comptes Rendus,* 202. *pp.* 1771–1773, *May* 25, 1936.—The work of Sève [see Abstract 2365 (1932)] has been extended to 1860 Å. Results for barytine and gypsum are tabulated, and it is shown that the birefringence increases rapidly in the region of the absorption bands. W. R. A.

4172. Dielectric Polarisation of the Elements. D. Doborzyński. *Acta Physica Polonica,* 4. 3. *pp.* 219–241, 1935. *In German.*—The connection between the values of the refractive indices of the elements in the gaseous state, and the periodic classification was noted by Cuthbertson in 1907. It is shown that values of the dielectric polarisation of the elements give the same results as those of the refractive indices. E. R.

4173. Refractivity and Dielectric Constant of Carbon Dioxide at High Pressures. P. O. John. *Phil. Mag.* 22. *pp.* 274–281, *Aug.,* 1936.—The deviations from the Lorentz formula in representing the refractive and dielectric behaviour of CO_2 over a wide range of densities are discussed on the basis of the theory of the anisotropic polarisation field in dense media put forward by Raman and Krishnan. It is found, in conformity with the predictions of the theory, (1) that the anisotropy of the polarisation field increases progressively with increase in density, and (2) that, for any given density, the degree of anisotropy required to explain the deviations from the Lorentz formula is the same for different wave-lengths of the incident light. AUTHOR.

4174. Transformation in Glass. Niuta Klein. *Comptes Rendus,* 203. *pp.* 180–182, *July* 15, 1936.—All glasses studied can exist in two allotropic forms A and B stable when cold and hot respectively, and having different physical constants. For borosilicate crown, the extreme refractive indices observed are 1·51640 and 1·52227. A transformation curve is found to have the form $\mu_\beta = \mu_a - Ae^{-Bt}$, where A and B are functions of temperature. It is seen that the transformation from one state to another may be made in different times depending upon the temperature employed. F. S.

4175. Change of Refractive Index during the Coagulation of Manganese Dioxide Sol. S. S. Joshi and S. J. Rao. *Kolloid Zeits.* 76. *pp.* 145–149, *Aug.*, 1936.—The authors have investigated alterations in the refractive index during the coagulation of the MnO_2 sol effected by solutions of HCl, Li_2SO_4, NaCl, KCl, NH_4Cl, $BaCl_2$, $AlCl_3$, $Ce(NO_3)_4$ and $Th(NO_3)_4$. The actual changes of the refractive index μ, were found to depend, during the course of the coagulation, on the specific condition of the coagulating agent and on its concentration. It appeared that the μ-time curves for all the cases examined had a variable or step-like form. This stepwise effect was particularly prominent in slow coagulations, and possesses special importance for any theory of the mechanism of such changes. Full experimental details are given with data and illustrative curves. H. H. Ho.

4176. Physical Properties of Lithium-Beryllium Borate Glass "Getan." S. Hertzrücken. *Techn. Phys., U.S.S.R.* 3. 4. *pp.* 336–349, 1936. *In German.*—A glass has been made which is transparent both to ultra-violet and to X-rays. The principles of its construction are explained and the composition is proved by X-ray methods. F. S.

See also Abstracts 3932, 3967, 4127, 4138, 4401, 4402, 4410, 4411.

SPECTROSCOPY.

4177. Ultra-Violet Wave-Length Standards of N, C, and O, λ2300 to λ1080. R. L. Weber and W. W. Watson. *J.O.S.A.* 26. *pp.* 307–309, *Aug.*, 1936.—Wave-lengths of N, C and O lines in the spectral range λ2317 to λ1080 have been determined with an accuracy of 0·01 Å to serve as wave-length standards in this region. A 10-ft. focus normal incidence vacuum spectrograph having a dispersion of 5·5 Å/mm. was used to compare second order N and C lines with first order Cu and Fe interferometer-measured standards. The results are compared with values given by Boyce and Rieke. The mean deviation from their values is 0·009 Å, the mean systematic deviation 0·001 Å. The use of the method of coincidences in determining tertiary standards is discussed. AUTHORS.

***4178. Wave-Length Standards in the First Spectrum of Krypton. C. V. Jackson.** *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 1–24, *Aug.* 27, 1936.—The wave-lengths of 47 of the brightest lines in the range λ3424–λ6456 have been compared directly with the primary standard. Two new types of etalon were designed and thicknesses of 0·5, 1, 2, 3, 5, 6, 7·5 and 10 cm. used for 120 direct comparisons. No systematic variation of wave-length was found, the results being thought accurate to 0·0001 or 0·0002 Å. Term values for 28 terms have been calculated. Neither the aspect of the tube nor the presence of considerable quantity of impurity is found to produce any measurable influence on wave-length. Pressure shifts of 30 lines have been measured using tubes filled at 0·1, 4, 10 and 20 mm. Hg. No shift is found if the pressure does not exceed 4 mm. except for a few u.v. lines. The use of krypton lines for determining the thickness of an etalon is exemplified by tables. F. S.

*4179. **Excitation of Light in Helium by Collisions of Positive Potassium Ions between 2500 and 8000 V. H. Bumann.** *Zeits. f. Physik*, 101. 1–2. *pp.* 1–12, 1936.—A new source of K-ions which enables currents up to 2×10^{-5} A to be obtained is described. It is shown that at the operating pressure of 4×10^{-2} mm. the number of atoms formed by discharging of ions is considerably less than 1 % of the number of ions and is, therefore, negligible. The excitation functions of 5876 and 4472 Å of He and of eight K II lines are measured between 2500 and 8000 V.
J. E. K.

4180. Optical L-Spectra of the Elements Potassium to Chromium K X, K XI, Ca XI, Ca XII, Sc XII, Ti XIII, V XIV and Cr XV. B. Edlén and F. Tyrén. *Zeits. f. Physik*, 101. 3–4. *pp.* 206–213, 1936.—The vacuum spark spectra of the metals K (19) to Cr (24) are photographed in the region 40 to 18 Å. In the cases of K and Ca about 20 lines are observed of the NeI- and FI-like spectra and in the cases of Sc, Ti, V and Cr 4 or 5 lines of the NeI-like spectrum are observed. Term systems are calculated for the NeI-like spectra. The shortest wavelength observed in the Cr XV spectrum is 18·5 Å and the ionisation potential is calculated to be 1008 V. J. E. K.

4181. New Terms in the Spectrum of Hg III. R. Ricard. *J. de Physique et le Radium*, 7. *pp.* 315–317, *July*, 1936.—Visible and near u.v. lines of Hg III which appear in great strength in the electrodeless discharge are accounted for by postulating some 30 new terms. No theoretical interpretation of these terms is possible. A. H.

4182. Displacement of Principal Series Lines of Rubidium by Rare Gases. Ny Tsi-Ze and Ch'En Shang-Yi. *Comptes Rendus*, 203. *pp.* 242–243, *July* 20, 1936.—He, Ne and A are employed in this study, and pressures going up to 13·6 atmospheres are used. The spectrum is obtained in absorption at temperatures up to 575° K. Displacements observed vary with the pressure, with the gas employed, and with the member of the series in question. A. H.

4183. Application of Method of Intermittent Illumination to the Investigation of Excited Atomic States. K. Krebs. *Zeits. f. Physik*, 101. 9–10. *pp.* 604–642, 1936.—A gas which contains excited atoms must also emit radiation, and this will disturb the absorption measurements. To avoid this, a method due to Houtermans [see Abstract 3480 (1933)] is used in which the transmitted light is made intermittent by means of a rotating disc, while the light emitted by the absorber is constant. The transmitted light can then be measured with a photoelectric cell and an a.c. amplifier. This method is applied to the $2s$–$3p$ transitions of Ne. Both the source of the transmitted light and the absorber are discharge tubes containing pure Ne. Thus in order to evaluate the results, one has to discuss the relative shape of emission and absorption line. In this way the numbers of atoms in the different excited states can be estimated. Such values are obtained in dependence on the current in the absorbing tube (except for very low currents, at which the discharge is not sufficiently constant for this method to be applied). R. P.

4184. Term Analysis of First Spectrum of Vanadium (V I). W. F. Meggers and H. N. Russell. *Bureau of Standards, J. of Research.* 17. 125–192, *July*, 1936.—All available data on 2525 V I lines (wavelengths, intensities, temperature classes, Zeeman effects, and absorption observations) subjected to analysis have aided in the identification of 60 doublet, 60 quartet, and 28 sextet terms. Combinations between these give 634 multiplets and account for 2186 observed lines. Complete tables of lines and terms are presented. The lowest term is $(d^3s^2)a^4\mathrm{F}_{1\frac{1}{2}}$, but the strongest line (*raie ultime* of V I) is $(d^4s)a^6\mathrm{D}_{4\frac{1}{2}} - (d^4p)y^6\mathrm{F}^\circ_{5\frac{1}{2}}$ with wave length 4379·24 Å, involving the simple *s–p* transition. Line intensities, level intervals, and Zeeman effects indicate that this 5-electron spectrum is governed, in the main, by LS coupling. The terms are all regular except for a few inversions, some of which appear to be explained by perturbations also accompanied by abnormal magnetic splitting. Absorption data and temperature classification confirm the orientation of the terms and agree qualitatively with their energies of excitation. Zeeman-effect observations for more than 900 lines greatly facilitated the analysis, and constitute convincing evidence for its correctness. With the aid of the quantum theory, and comparisons with other spectra, the electronic configurations responsible for the observed terms have been identified in nearly all cases, but a few terms are left unassigned for various reasons. A number of two-member series have been recognised; from them a corrected ionisation potential of 6·71 volts has been computed for neutral V atoms. AUTHORS.

4185. Intensity Distribution in the Line Emission Spectrum of Cæsium. F. L. Mohler. *Bureau of Standards, J. of Research,* 17. *pp.* 45–54, *July,* 1936.—The intensity in a series of lines is $J_n = h\nu N_n A_n$, where N_n is the number of atoms per c.c. in the *n*th state, and A_n is the rate of radiation per atom. A_n is proportional to n^{-3} for large values of *n*, while for a limited range of conditions N_n is known to have a temperature distribution. Line intensities were measured by direct comparison with spectra of a strip lamp. Plots of log J/ν^4 versus log *n* give parallel curves for the S, D, and F series, and the form of the curve is nearly independent of current and pressure for pressures above 70 μ. Measurements of the D series corrected for self-absorption give plots of log Jn^3 versus term energy, which are straight lines with slopes consistent with measured values of reversal temperature for the P series. Measurements of intensity of two D series lines over a wide range of conditions show the intensities are proportional to the continuous spectrum intensity at the higher pressures. For pressures above 70 μ the excited states have a temperature distribution from $n = 4$ to 14. For the D series $A_n = (6{\cdot}4 \times 10^8/n^3)$ $(\lambda_n/5635)$. The values of A/ν^3 are about twice the theoretical hydrogen values. The values for the F series are also about twice the hydrogen values, while for the S series they are 16 times the hydrogen values. There is evidently an equilibrium between the number of ions and the number of excited atoms at high pressure, and in the same range of discharge conditions the temperature distribution of excited states is found. AUTHOR.

4186. Relative Intensity of the Neon Lines 744 and 736 Å against their Higher Members. T. Takamine and T. Suga. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 639. *pp.* 207–212, *July,* 1936. *In English.*—The first member of the resonance series of neon 744 Å, 736 Å appear remarkably strong when pure Ne is used at several mm. pressure, while the higher members appear only very weak. The exact opposite occurs with He containing a trace of Ne. Here the two lines 744 Å and 736 Å are seen only with moderate intensity, whereas all the higher members are considerably enhanced. This remarkable feature is seen whether a disruptive discharge, or a d.c. arc is used for the excitation, although in the latter case, the contrast is not so striking as in the former. As an interpretation, it is suggested that the change in electron temperature in the case of using a mixed gas may be accountable for producing the phenomenon. [See also Abstract 2202 (1936).] AUTHORS.

4187. Hyperfine Structure of Lead, Pb III. A. M. Crooker. *Canad. J. of Research,* 14. *Sect. A. pp.* 115–126, *June,* 1936.—The hyperfine structures in the spectrum of Pb III, excited by an electrodeless discharge, are studied by means of a 21 ft. concave grating. The hyperfine structure patterns lead to an I-value of $\frac{1}{2}$ and a $g(I)$ factor of $1 \cdot 2$ for the odd isotope Pb^{207}_{82}, in agreement with the results of previous workers. The isotope shifts between the even isotopes Pb^{206}_{82} and Pb^{208}_{82} are in agreement with Breit's theoretical interpretation, and amount to $0 \cdot 5$ cm.$^{-1}$ for each 6s electron. The fact that the deep terms in the spectrum of Pb III are rather completely known permits an attempt to be made at a careful comparison between experiment and theory. AUTHORS.

4188. Hyperfine Structure of the Platinum Isotopes. Part III. Determination of Abundance Ratios of Platinum Isotopes by Intensity Measurements of the Hyperfine Structure Components of some Pt I Lines. H. Kopfermann and K. Krebs. *Zeits. f. Physik,* 101. 3–4. *pp.* 193–205, 1936.—The relative intensities of the components of some Pt I lines whose hyperfine structure has been analysed previously [see Abstract 3206 (1936)] are measured photographic-photometrically and the relative abundances of the isotopes are thereby determined. The relative abundances $Pt^{194} : Pt^{195} : Pt^{196}$ and Pt^{198} are found to be 19 : 20 : 13 : 5. J. E. K.

4189. Nuclear Magnetic Moment of $^{195}_{78}Pt$. T. Schmidt. *Zeits. f. Physik,* 101. 7–8. *pp.* 486–488, 1936.—A discussion of the observations of Jaeckel and Kopfermann [see Abstracts 2205 and 3206 (1936)] leads to a value of $0 \cdot 6$ nuclear magneton. R. P.

4190. Nuclear Spins and Magnetic Moments of Rb^{85} and Rb^{87}. S. Millman and M. Fox. *Phys. Rev.* 50. *pp.* 220–225, *Aug.* 1, 1936.—The atomic beam method of " zero moments " has been applied to measure the nuclear spins and h.f.s. separations, Δv, of the $^2S_{\frac{1}{2}}$ states of Rb^{85} and Rb^{87}. We find the spin of Rb^{85} to be **5/2** and that of Rb^{87} **3/2**, in agreement with the most probable values given by Kopfermann. With the value of $\Delta\nu$ for sodium as a standard we were able to measure the $\Delta\nu$'s of the Rb isotopes with a precision of 1 %. We find these values to be $0 \cdot 1018$ cm.$^{-1}$ for Rb^{85} and $0 \cdot 229$ cm.$^{-1}$ for Rb^{87}, as compared with Kopfermann's values of $0 \cdot 105$ and $0 \cdot 240$ cm.$^{-1}$ respectively. The magnetic moments calculated from the modified Goudsmit formula, are $1 \cdot 44$ nuclear magnetons for Rb^{85} and $2 \cdot 92$ for Rb^{87}. The ratio of magnetic moments, μ_{87}/μ_{85}, is found to be $2 \cdot 026$, with a precision of $0 \cdot 2$ % The $\Delta\nu$ for Cs was also measured with a precision of 1 % The result, $0 \cdot 307$ cm^{-1}., is in excellent agreement with the value $0 \cdot 3067$ cm^{-1}. of Granath and Stranathan. AUTHORS.

4191. Variational Wave Functions of Doubly Excited States of Helium. Ta-You Wu and S. T. Ma. *Chinese Chem. Soc., J.* 4. *pp.* 344–353, *July,* 1936. *In English.*—The wave functions of the states $(2s)^2\ {}^1S$; $2s2p\ {}^3P, {}^1P$; $(2p)^2\ {}^3P, {}^1D, {}^1S$; $2s3s\ {}^3S, {}^1S$; $2s3p\ {}^3P, {}^1P$; $2s3d\ {}^3D$; ${}^1D$ of He and their energies are obtained by the variational method. AUTHORS.

4192. Band Spectra of Cuprous Halides. E. Rosa. *N. Cimento,* 13. *pp.* 214–219, *May,* 1936.—The emission bands of CuCl, CuBr and CuJ are obtained in a carbon arc, and their intensity distribution is determined in dependence on pressure. It is found that a decrease in pressure changes both the distribution of intensities within every band system and the relative intensities of different band systems in the sense to be expected from a decrease in effective temperature. Similarly the width of the rotational structure (although this could not be resolved) decreases with decreasing pressure. R. P.

4193. Spectrum of Præsodymium Oxide in the Vapour State. G. Piccardi. *Accad. Lincei, Atti,* 23. *pp.* 358—361, *March* 1, 1936.—The author photographed the spectrum of præsodymium oxide using his new flame method and gives a table of the wave-lengths of the bands observed (the dispersion was insufficient to resolve the individual lines). The spectrum is identical with that previously reported in 1929. W. S. S.

4194. Absorption of Aqueous Solutions from 0·7 μ to 0·9 μ. E. Ganz. *Zeits. f. phys. Chem.* 33. *Abt.B.* 3. *pp.* 163–178, 1936.—The dependence of absorption upon concentration and temperature for various sodium salts, acids and bases is investigated. The absorption of salt solutions at 12° follows closely that of water at higher temperature, this increasing with the anion of the salt. A similar influence is found with acids. F. S.

4195. Infra-Red Absorption of Liquid Hydrocarbons. Influence of the Double Bond. J. Errera, P. Mollet and Mary L. Sherrill. *Comptes Rendus,* 202. *pp.* 2141–2142, *June* 29, 1936.—*n*-Pentane, *n*-heptane, 5 pentenes, 1 hexene, and 3 heptenes have been examined and the influence of the position of the double bond on the location of the band is discussed. W. R. A.

4196. New Absorption Band in KBr Crystals. E. Rexer. *Phys. Zeits.* 37. *p.* 523, *July* 15, 1936.—By heating pure KBr crystals for a long time in air at high temperature an absorption band with maximum at 302 mμ and of half-width 0·25 eV, is observed. Absorption in the region of this band does not give rise to photochemical colouring, but to the emission of a fluorescent light with maximum at 453 mμ and of half-width 0·25 eV. G. C. McV.

4197. Effect of Association on the Infra-Red Absorption Spectrum of Acetic Acid. R. H. Gillette and F. Daniels. *Am. Chem. Soc., J.* 58. *pp.* 1139–1142, *July,* 1936.—The infra-red absorption spectrum of acetic acid has been obtained at 25° and at 172°—corresponding to the single and the associated molecule. At intermediate temperatures both spectra appear. Three of the fundamental frequencies are the same in both molecules and two are shifted. These two must be intimately connected with the association process. Modes of vibration of the two molecules are suggested, corresponding to the fundamental frequencies. The results of this investigation suggest that the association of carboxylic acids to give dimers occurs through the formation of hydrogen bonds leading to ring structure which gives rise to different absorption frequencies. AUTHORS.

4198. Effect of Substitution on the Infra-Red Absorption Spectrum of Acetic Acid. R. H. Gillette. *Am. Chem. Soc., J.* 58. *pp.* 1143–1144, *July,* 1936.—The infra-red absorption spectra of acetic acid and eight substituted acetic acids are measured in CCl_4 solution. Certain uniform shifts in the absorption bands are observed and correlated with other measurements. AUTHOR.

***4199. Infra-Red Absorption of CS_2 at 4·57μ. J. A. Sanderson.** *Phys. Rev.* 50. *pp.* 209–211, *Aug.* 1, 1936.—The rotational structure of the infra-red absorption band of CS_2 lying at 4·577μ has been partially resolved. Average values of B and B′ were found to be 0·112 and 0·111, while the separation of the P and R branches of the band is 13·3 cm^{-1}. The best representation of the positions of the rotational lines is by means of the relation $\nu = 2184\cdot 50 + 0\cdot 224M - 0\cdot 00025M^2$. The location of the centre of the band at $2184\cdot 5$ cm.$^{-1}$ does not agree with previous determinations of 2179 cm.$^{-1}$ and 2167 cm.$^{-1}$ by Bailey and Cassie. [See Abstracts 3805 (1931) and 3567 (1933).] AUTHOR.

4200. Absorption Spectrum of Methyl Alcohol Vapour in the Photographic Infra-Red. R. M. Badger and S. H. Bauer. *J. Chem. Phys.* 4. *pp.* 469–473, *Aug.*, 1936.—The absorption of methyl alcohol vapour in the photographic infra-red is explored under low dispersion. Absorption regions are found at λ9500 and λ7300, which correspond to two harmonics of the O — H vibration, and at λ12,000 which is a harmonic of the C — H vibration. The two O — H harmonic bands are investigated under high dispersion and a somewhat complex rotational structure is resolved. The complete interpretation of the spectrum must be postponed until the theory of the torsion oscillator rotator is further developed. AUTHORS.

4201. Benzene Vibrations Deduced from Ultra-Violet Absorption Spectra. K. Masaki. *Chem. Soc. Japan, Bull.* 11. *pp.* 346–348, *April*, 1936. *In English.*—Vibration frequencies of toluene, chlorobenzene, bromobenzene, phenol, aniline, benzaldehyde and benzonitrile in the vapour state are deduced from their absorption spectra in the ultra-violet. These are compared with known Raman frequencies. A. C. M.

4202. Absorption Coefficients of Oxygen Bands 4774, 5770, 6290 Å. L. Herman and Renée Herman-Montagne. *Comptes Rendus,* 202. *pp.* 2064–2066, *June* 22, 1936.—Measurements of these coefficients were made for pressures varying between 4 and 12 kg./cm^2. The absorption was found to vary proportionally to the square of the pressures. From the figures obtained it is found that the absorption of the sun's rays due to oxygen in the atmosphere is appreciable only at very large zenith angles. D. H. F.

4203. Variation of the Ultra-Violet Spectra of Phenol as a Function of pH. Madeleine Gex. *Comptes Rendus,* 202. *pp.* 2145–2147, *June* 29, 1936.—The variation of the absorption of aqueous solutions of phenol is investigated as a function of pH for the range 2 to 12. There is a principal band at 269, between bands at 262 and 276 $\mu\mu$, and separated by a minimum at 237 from another band towards the extreme ultra-violet. In very alkaline media the spectrum is displaced towards longer wavelengths, the maximum and minimum being at 286 and 259 $\mu\mu$, respectively; at the same time the former becomes less and the latter more intense. An interpretation of results is discussed, and shows that for pH 1–7 a form A exists and changes tautomerically below pH 9 to form B; above pH 9 appears form C. N. M. B.

4204. Ultra - Violet Absorption Spectra of Normal and Leucæmic Blood. I. Magat and M. Magat. *Comptes Rendus,* 202. *pp.* 2181–2184, *June* 29, 1936.—Using the comparison method of V. Henri, absorption spectra of dilute aqueous solutions of blood were obtained in the wave-length range 2400 to 4500 Å, using a dispersion of 6 Å/mm. In normal blood five bands are found, at 4110 Å attributed to hæmine, at 2800 Å attributed to protein absorption, at < 2400 Å attributed to globuline, together with a broad band at 3430 Å and a very narrow band at 2895 Å, both of unknown origin. In the case of leucæmic blood the wavelengths of the absorption bands are identical with those of the normal, but there is a definite increase in the absorption in the 2895 and 2800 Å bands. It is suggested that this enhancement may be due to the presence in the blood of carcinogenic compounds, which have absorption bands in that region. J. E. R.

4205. Absorption of $TeCl_2$ and $TeOCl_2$. M. Kantzer. *Comptes Rendus*, 203. *pp*. 163–164, *July* 15, 1936.—Absorption bands of $TeCl_2$ are observed between λ3960 and λ4358, and of $TeOCl_2$ between λ5015 and λ5750. The conditions being identical the existence of a set of bands for $TeOCl_2$ distinct from those for $TeCl_2$ is taken as proof of the existence of the oxychloride. A. H.

4206. Absorption of Light by Porphyrins. Part VI. A. Stern, H. Wenderlein and H. Molvig. *Zeits. f. phys. Chem.* 177. *Abt.A*. 1. *pp*. 40–81, 1936.—Previous work is continued [see Abstract 2219 (1936)] and numerous results are reported. *Inter alia*, it is found that the absorption spectrum of porphin shows six bands in the visible region in all the different solvents investigated, a new band being found in the red. The absorption and fluorescence spectra of a number of di- and tetra-substituted porphyrins show regularities according to the position of the substituents. Some copper derivatives of di-, tetra- and octa-substituted porphyrins are investigated. All have two absorption bands, the form of which alters with the number of substituents. The frequency difference between the band maxima is affected by the presence of those groups which give rise to the " rhodo " type of absorption curve in the metal-free porphin system. From absorption data conclusions are drawn as to the structure of a β-δ-diimido-porphyrin and a mono-imido-porphyrin. Introduction of a Cu atom into a diimido-porphyrin system causes changes of absorption similar to those brought about by the introduction of Mg into the dihydroporphin system. An account is given of the absorption of a pyrromethene with a band in the red as well as in the blue. The band in the red is regarded as due to the presence of a labile H atom and formation of a tautomeric form. L. A. W.

4207. Absorption of Light by Porphyrins. Part VII. A. Stern and H. Wenderlein. *Zeits. f. phys. Chem.* 177. *Abt.A*. 3. *pp*. 165–192, 1936.—The influence of various substitutions in the dihydroporphin system upon absorption spectra is investigated. The purpurins and the rhodins possess the same skeletal structure (dihydroporphin system) and the differences in absorption types are due to substitution. The absorption curves of chlorin p_6 and pseudo-chlorin p_6 differ markedly, and the probable stereoisomerism of these two compounds is discussed. Conclusions as to structure are drawn from observed regularities in the absorption spectra of compounds containing a carbonyl group in various positions. The alteration of the fluorescence spectrum in the transition porphin to dihydroporphin system is also studied. The introduction of Mg merely causes displacement of the fluorescence bands towards the red. Only the vinyl group in the 2-position and the altered nuclear structure in the dihydroporphin system change the type of the fluorescence spectrum. L. A. W.

4208. Optical Behaviour of Dissolved Ions and its Significance in the Structure of Electrolytic Solutions. Part IV. G. Kortüm. *Zeits. f. phys. Chem.* 33. *Abt.B*. 4. *pp*. 243–264, 1936.—In this paper, the non-specific influence of the refractive index of the solvent on the validity of the Lambert-Beer law in aqueous solutions of inorganic salts is discussed in connection with dispersion data previously obtained from solutions of the sodium salt of eosine. For a molar concentration region of $C < 10^{-2}$, this influence can in general be neglected even in exact measurements. Photo-methods for testing the Beer law to the greatest possible degree of accuracy are described. Measurements for aqueous solutions of $K_3[Fe(CN)_6]$, $K_4[Fe(CN)_6]$, KNO_3, KNO_2, K_2CrO_4 and $K_2Cr_2O_7$ in the vicinity of different solution bands, indicate that in no single case can the Beer law be regarded as valid over the entire absorption range. So far as this validity occurs in separate cases, it only holds in the region of a band, while in other parts of the spectrum considerable deviations can occur. The valid region varies from case to case and depends on the disturbance sensitivity of the respective band. On the other hand, the extinction coefficient approaches a constant limiting value at sufficiently high dilutions for all the cases investigated, which is given exclusively by the interaction of ion and solvent. This is a further proof that deviations from the Beer law in aqueous salt solutions are not due to the action of Coulomb force fields, but mainly to a disturbance of the forces of hydration or to the reciprocal effects of chemical forces. [For Part III see Abstract 3667 (1936).] H. H. Ho.

4209. Substitution and Shift of Absorption Bands of Dihalogenbenzols. H. Conrad-Billroth and G. Förster. *Zeits. f. phys. Chem.* 33. *Abt.B.* 4. *pp.* 311–318, 1936.—The spectra of 13 two-fold halogen-substituted benzol compounds were studied. Only the chlorine- and bromine derivatives follow the addition law, while those containing fluorine show unexplained deviations. Contrary to expectation, molecules containing iodine show a separation of the benzol and iodine spectra. F. S.

4210. New Band Systems of SeO_2, Se_2 and Te_2. Choong Shin-Piaw. *Comptes Rendus*, 203. *pp.* 239–241, *July* 20, 1936.—The absorption spectra of SeO_2, Se_2 and Te_2 are examined as far as λ1777, using as source a hydrogen discharge tube. For SeO_2 at 200° C. a band system extends from λ2069 to λ2195; with higher temperatures bands are visible to λ2400. The system is degraded to the red and can be represented by $\nu_h = 45{,}554{\cdot}0 + 558v' - 0{\cdot}5v'^2 - 767v'' + 12v''^2$. In the case of Se_2 absorption commences at 230° C. and extends from λ1777 to λ1939. Two systems are observed. For the A system the heads are sharp and degraded to the violet and the dozen or so heads fit the formula $\nu_h = 52{,}340{\cdot}0 + 203v' - 0{\cdot}6v'^2 - 381v'' + 0{\cdot}3v''^2$. Fewer heads are visible in the B system, and these are extremely diffuse. The absorption centres fit the formula $\nu = 56{,}254{\cdot}0 - 396v'' + 0{\cdot}2v''^2$. The Te_2 absorption spectrum extends from λ1975 to λ2495. At 430° C. some 30 bands are visible from λ1975 to λ2107. As the temperature is raised the system extends to λ2495. Save for some very weak heads the heads are sharp and degrade to the violet. The majority of the bands visible at 430° C. can be represented by $\nu_h = 49{,}567{\cdot}0 + 190v' - 257v'' + 1{\cdot}8v''^2$. The bands which appear at temperatures above 430°C. do not fit any scheme. A. H.

4211. Rotational Analysis of Ångström Bands at λλ6080 and 6620. R. K. Asundi. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 554–561, *June*, 1936.—The rotational analysis of the (0, 4) and (0, 5) bands of the $B'\Sigma \rightarrow A'\Pi$ system of CO is given. On account of the low temperature production only relatively low J values are obtained. No perturbations are found in the (0, 5) band, but the P and R branches of the (0, 4) are perturbed. The origin of the perturbations is discussed at length. A. H.

4212. Analysis of the (1, 0) $b^3\Sigma - a^3\Pi$ CO-Bands. L. Gerö. *Zeits. f. Physik*, 101. 5–6. *pp.* 311–322, 1936.—The bands, which occur at 2673 Å, were photographed with a dispersion of 1·2 Å per mm. in the first order of a 6·5 m. grating with 30,000 lines per in. The observed data and rotation analysis are given. The predissociation of the $b^3\Sigma$ state is between K = 42 and 43, while the vibration constant of this state is $\omega(1 - x) = 2198$ cm.$^{-1}$. F. S.

4213. Rotation-Vibration Spectrum of C_2H_2. R. Mecke and R. Ziegler. *Zeits. f. Physik*, 101. 7–8. *pp.* 405–417, 1936.—Recent investigations have shown that the vibration analysis of the infra-red bands of C_2H_2 and other polyhydrides is not satisfactory. A new system is proposed, embodying eight new bands at 11005, 10925, 10678, 9645, 9600, 7670, 7555 and 5707 Å. An accurate value of 612·3 for the $\delta(s)$ oscillation is obtained. D. H. F.

4214. Isotope Effect in Ionised Mercury Hydrides. ($Hg^+ H/Hg^+ D$). T. Hori and J. Huruiti. *Zeits. f. Physik*, 101. 3–4. *pp.* 279–284, 1936.—Analysis of the $^1\Sigma \rightarrow {}^1\Sigma$ bands of Hg^+H and Hg^+D shows that the isotope-ratio calculated from the rotation constant B_e has the same value as that deduced from the atomic weight determination. This means that the electrons in the molecule take part in the rotation as if one electron is bound to the hydrogen atom, which is assumed in the customary theory. When the vibrations are considered, it is found that better agreement with the spectroscopic data is obtained if it is considered that effectively *eight* electrons are bound to the hydrogen nucleus. A. C. M.

4215. Dissociation Energy of Carbon Monoxide. R. K. Asundi and R. Samuel. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 562–565, *June*, 1936.—The various values for the dissociation energy of the CO molecule deduced from rotational pre-dissociation data are discussed, and objections, both experimental and theoretical, are indicated. The value of 10·45 volts is held to be an upper limit, and a lower value of 9·57 volts would agree well with thermochemical considerations. A. H.

4216. Calculation of Potential Curves for Hydrogen Molecular Ions. G. Steensholt. *Zeits. f. Physik*, 100. 9–10. *pp.* 547–548, 1936.—Theoretical. W. R. A.

4217. Rotational Constants of the IV Positive CO-Bands. R. Schmid and L. Gerö. *Zeits. f. Physik*, 101. 5–6. *pp.* 343–351, 1936.—The rotational constants of the IV positive CO-bands [see Abstract **3222** (1936)] $A^1\Pi \rightarrow X^1\Sigma$ are accurately expressible by the equations B'_v (cm.$^{-1}$) $= 1{\cdot}6116 - 0{\cdot}02229\ (v + \frac{1}{2}) - 0{\cdot}000105\ (v + \frac{1}{2})^2$ and B''_v (cm.$^{-1}$) $= 1{\cdot}9300 - 0{\cdot}01736\ (v + \frac{1}{2})$. The value 6×10^{-6} cm.$^{-1}$ could be assumed throughout for D_e. Although from considerations of the vibrational terms a quadratic term in $(v + \frac{1}{2})$ is to be expected with a coefficient of the order of 10^{-4} in the equation for $B''v$, the results indicate that the coefficient must actually be much smaller (of the order of 10^{-6}). L. A. W.

4218. Transfer of Rotational Energy in Molecular Collisions. Part I. Elementary Processes which Lead to Abnormal Rotation of the HgH Molecule. F. F. Rieke. *J. Chem. Phys.* 4. *pp.* 513–525, *Aug.*, 1936.—By the application of photographic photometry, the intensity distribution within the HgH 4017 band excited by mercury-sensitised fluorescence is studied as a function of the pressure of N_2 and the pressure of water-vapour present in the fluorescence tube. From the effect which the foreign gases exert on the observed distribution of molecules among rotational levels, conclusions are drawn regarding the transfers of energy which occur in collisions of the HgH molecule with metastable Hg atoms and with normal H_2O and N_2 molecules. The proportion of excited HgH molecules with rotational energy greater than 0·2 V greatly exceeds the thermal value under all circumstances; the excess rotational energy has its source in the two following processes. In a collision between an unexcited HgH molecule and a metastable Hg atom, the excitation energy of the latter is sometimes taken up as both rotational and electronic energy of the HgH molecule. In a collision between a normal N_2 molecule and a highly excited HgH molecule, part of the electronic and vibrational energy of the latter is converted into rotational energy. AUTHOR.

4219. Energy Losses of Electrons in Molecular Nitrogen. J. E. Roberts, R. Whiddington and E. G. Woodroofe. *Roy. Soc., Proc.* 156*A*. *pp*. 270–283, *Aug*. 17, 1936.—The energy losses suffered by electrons in collision with nitrogen molecules are determined by means of a method described previously. The bombarding voltages employed were 120 and 16–25 V, and the interpretation of the results is discussed. It is shown, *inter alia*, that for the transition $X^1\Sigma_g - a^1\Pi_u$ a nuclear separation of 1·21 Å (rather than the value 1·19 Å deduced spectroscopically) fits the facts well. AUTHORS.

4220. Theory of Absorption Spectra of Insulating Crystals. A. Smekal. *Phys. Zeits.* 37. *pp*. 554–556, *Aug*. 1, 1936.—Discussion of certain properties of absorption bands in crystals. The opinion is expressed that the absorption is due to the transition of electrons from atoms adsorbed on inner surfaces to excited levels inside the crystal. R. P.

4221. Light Absorption of Gases in the Far Ultra-Violet. G. Rathenau. *Physica*, 3. *pp*. 727–728, *July*, 1936. *In German*.—The continuous absorption of light from a capillary spark discharge by the gases NH_3, N_2, N_2O, CO_2 and C_6H_6 is measured with a vacuum grating spectrograph in the region 100 to 270 Å. The ratios of the absorption coefficients are found to be respectively 1 : 2·1 : 2·8 : 2·7 : 6·3. These ratios correspond approximately to the absorption to be expected from addition of the individual atoms without reference to their arrangements in the molecules. J. E. K.

4222. Continuous Absorption Spectrum of Bromine: New Interpretation. A. P. Acton, R. G. Aickin and N. S. Bayliss. *J. Chem. Phys.* 4. *pp*. 474–479, *Aug*., 1936.—The continuous absorption spectrum of Br was investigated quantitatively at six temperatures from 293° K. to 906° K., and the contributions of the vibrational levels $v'' = 0$ and $v'' = 1$ to the total continuum were deduced from the variation of the absorption coefficients with temperature. Contrary to expectation, the absorption from the level $v'' = 1$ has *three* maxima and not two, and the absorption from $v'' = 0$ has a decided hump on the long wave-length side of the maximum. These results can be explained if the Br continuum is composed of two overlapping continua, the stronger one (A) with its maximum at λ4150, and the weaker (B) with its maximum at λ4950. Although it is possible to assign A to the transition $^3\Pi_{0+u} \leftarrow {}^1\Sigma_g{}^+$, and B to $^3\Pi_{1u} \leftarrow {}^1\Sigma_g{}^+$, better agreement with the Franck-Condon principle is obtained if A is assigned to $^1\Pi_u \leftarrow {}^1\Sigma_g{}^+$, and B to $^3\Pi_{0+u} \leftarrow {}^1\Sigma_g{}^+$. The latter interpretation is also correlated with what is known of the Cl and I continua. On either assumption, the value of r_e for $^3\Pi_{1u}$ of Br is predicted to be about 2·6 Å. AUTHORS.

4223. Abnormal Zeeman Effect. F. J. Wiśniewski. *Acta Physica Polonica*, 4. 3. *pp*. 205–213, 1935. *In French*.—The author's corpuscular mechanics is applied to the problem of the movement of an electron under the influence of an external magnetic field which gives a ready explanation of abnormal Zeeman effects for alkaline atoms. The paper is theoretical. F. S.

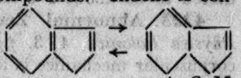
4224. Stark Effect of the Rotation Spectrum and Electrical Susceptibilities at Higher Temperatures. S. K. Chakravorti. *Zeits. f. Physik,* 102. 1–2. *pp.* 102–111, 1936.—A disturbance calculation by the Basu method [see Abstracts 44 and 502 (1931)] of the chain fraction has shown agreement with the results of Reiche and Manneback [see Abstract 1620 (1927)] so far as the Stark effect of the first order is concerned. Deviations, however, occur from Manneback's results for the second order effect, calculated for the symmetrical pyramidal molecule. On the other hand the expression for the energy of the ground state and the statistically derived electrical susceptibility agree completely with the values of Manneback, although the expression for the susceptibility deviates from the classical Langevin-Debye formula. The paper is mathematical throughout. H. H. Ho.

4225. Longitudinal Stark Effect of the Balmer Series. H. Bomke. *Phys. Zeits.* 37. *pp.* 417–427, *June* 15, 1936.—The dissymmetry of intensity of the components is shown to be different. The dissymmetry depends upon the gas pressure, being greatest at 8×10^{-3} mm. An additional magnetic field of about 200 gauss also has an influence depending upon its direction and that of the motion of the canal rays. [See following Abstract.] F. S.

4226. Polarisation of Light Emitted by Canal Rays. J. Stark, R. Ritschl and H. Bomke. *Phys. Zeits.* 37. *pp.* 427–431, *June* 15, 1936. —A magnetic field of 30,000 gauss was found to be without noticeable effect upon the polarisation of light from stationary He atoms, while some effect was found in H_2. Such a field, however, increases the polarisation in both gases for the case of moving canal rays. [See preceding and following Abstracts.] F. S.

4227. Polarisation of Light Emitted by Canal Rays. J. Stark and M. Schön. *Phys. Zeits.* 37. *pp.* 431–435, *June* 15, 1936.—The influence of various factors upon the ratio of light intensity polarised parallel and perpendicular to the direction of canal rays is considered. Gas pressure is shown to be important to the presence of other gases—O_2 and N_2 having less influence than He upon lines due to H_2. Lines belonging to different series of the same element are found to be differently affected. [See preceding Abstract.] F. S.

4228. Raman Effect of Homocyclic Compounds. K. Matsuno and K. Han. *Chem. Soc. Japan, Bull.* 11. *pp.* 321–345, *April,* 1936. *In English.*—The Raman spectra are repeated for benzene, cyclohexane, phenylcyclohexane, di-cyclohexyl, indene, naphthalene, tetrahydro-naphthalene, decahydro-naphthalene, tetrahydro-acenaphthene, decahydro-acenaphthene, decahydro-pyrene, perhydro-pyrene. Considering phenyl-cyclohexane, tetrahydro-naphthalene, tetrahydro-acenaphthene and decahydropyrene as substitution products of benzene as well as of cyclohexane, the Raman frequencies of these substances have been classified into three groups—(1) those due to the benzene ring, (2) those due to the cyclohexane ring, and (3) those due to the combination of the two. The disappearance of $\Delta\nu$ 616 and 1000 cm^{-1}. in the di-derivatives (ortho) of benzene has been confirmed in the case of the condensed ring compounds. Indene is considered as having a resonance between the forms



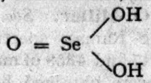
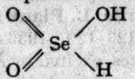
A. C. M.

4229. Raman and Infra-Red Spectra of Meta- and Para-Dimethylcyclohexane Isomers [Cis and Trans], and of Dimethyl-1-1-Cyclohexane. J. Lecomte, L. Piaux and O. Miller. *Soc. Chim. de Belgique, Bull.* 45. *pp.* 123–129, 1936.—The Raman spectra are recorded for the above substances, excited by $\lambda\lambda$ 4047 and 4358 of mercury. The infra-red spectra for the same substances were obtained between 510 and 1450 cm^{-1}. by using a registering spectrograph employing first a rock-salt and later a sylvine prism. The observations made are considered along with those previously made for the ortho-compounds [see Abstract 2526 (1934)]. There was no resemblance between the spectra of the ortho, meta and para compounds. The authors remark on the number of lines which in the Raman spectrum have no counterpart in the infra-red, and emphasise the need for investigating both types of spectra to obtain an idea of structure. A. C. M.

4230. Raman Spectra of some Substituted Epoxy-Cyclopentanes. E. Canals, M. Mousseron, L. Souche, P. Peyrot. *Comptes Rendus,* 202. *pp.* 1989–1992, *June* 15, 1936.—The Raman spectra of the following compounds are recorded, compared and discussed :—methyl-1-cyclopentene-Δ_1, same compound Δ_2 (racemic), same Δ_3 (inactive), propyl-1, cyclopentene Δ_1, isopropyl-1-cyclopentene Δ_1, epoxycyclopentane-methyl-1-epoxy-1·2-cyclopentane, same compound 2·3, same 3·4, ethyl-1-epoxy-1·2-cyclopentane, propyl-1-epoxy-1·2-cyclopentane, propyl-1-epoxy-1·2-cyclopentane, propyl-1-epoxy-1·2-cyclopentane, isopropyl-1-epoxy-1·2-cyclopentane. A. C. M.

4231. Raman Spectra of Some Substituted Epoxy-Cyclohexanes. E. Canals, M. Mousseron, L. Souche and P. Peyrot. *Comptes Rendus,* 202. *pp.* 2084–2086, *June* 22, 1936.—The Raman frequencies of substituted epoxy-cyclohexanes are compared with those of cyclohexane, and those of the substituted epoxy-cyclopentanes. A. C. M.

4232. Raman Spectra of Propylene and Iso-Butane. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 527–532, *June,* 1936.—The Raman spectrum of propylene is reported in detail and the observed frequencies are discussed in the light of the knowledge of their state of polarisation. The frequencies 1648, 920 and 432 are identified as the fundamental frequencies of the carbon chain, the first two being of the valence type, while the third one represents a deformation frequency. The 14 additional lines are to be attributed to the oscillations of the H atoms. The Raman lines of propylene are characterised by extreme sharpness, and are more or less well polarised. The Raman spectrum of iso-butane forms a striking contrast, many of the lines being extremely broad and highly depolarised. It is suggested that this difference might be due to the symmetry of the iso-butane molecule which causes many of the vibrations to be degenerate. An attempt is made to interpret the spectrum of iso-butane with the help of the polarisation data. The close similarity between the Raman spectra of iso-butane and chloroform as revealed by polarisation studies is pointed out. AUTHOR.

4233. Raman Spectra of Selenious Acid and its Sodium Salts. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 533–543, *June,* 1936.—The Raman spectra are investigated for selenious acid as crystals and as aqueous and alcoholic solutions of various concentrations, and for sodium biselenite and sodium selenite. The solid is rich in intense, sharp lines, of the following frequencies in cm^{-1}. :—124, 199, 254, 287, 299, 364, 524, 597, 706, 862, 889, 909 and 940. The lines change in intensity and broadness when the crystals are dissolved. Two lines in particular do this, 706 and 597, and to explain this two types of molecule are postulated,  $\mathrm{O=Se(OH)_2}$ and  $\mathrm{O_2Se(OH)H}$, in dynamic equilibrium in the acid. In the solid and in methyl alcohol solution the latter type predominates, while the first type predominates in aqueous solution. Comparison of the spectra of aqueous solutions of different concentrations indicate that the dissociation of the acid is weak. The line 895 cm^{-1}. is allocated to the $HSeO_3'$ ion. Two of the low frequency vibrations in the solid are attributed to hindered vibrations, and one to the vibration of polymerised groups of molecules. A. C. M.

4234. Raman Effect and Dipole Moment in Relation to Free Rotation. Part IV. Molecular Structure of Acetylene Tetrachloride. S. Mizushima, Y. Morino and K. Kozima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 633. *pp.* 111–121, *June*, 1936. *In English.*—Following up the methods previously used for ethylene dihalides the investigation of acetylene tetrachloride has been carried out. The behaviour of the intramolecular potential is quite different from that of ethylene dihalide. [For Part III see Abstract 3235 (1936).] W. R. A.

***4235. Recording Spectrometer. P. Lambert and J. Lecomte.** *Comptes Rendus*, 203 *pp.* 164–167, *July* 15, 1936.—A recording spectrometer adapted for the region around 3000 cm^{-1}. is described. The instrument is being used to study the very complex absorption spectra of benzene and similar compounds between 2500 and 3700 cm^{-1}. A. H.

***4236. Quantitative Spectroscopic Determination of Si and Cr in Malleable Cast Iron. S. Mandelstam, S. Raiskiy, and W. Zehden.** *Techn. Phys., U.S.S.R.* 3. 4. *pp.* 321–335, 1936. *In German.*—A condensed spark is used as source and a visual spectroscope with photometric eyepiece is described, comparison of intensity of selected lines with neighbouring iron lines being made. The range of content is 0·4 % – 2 % for Si and 0·02 % – 0·1 % for Cr. A determination of both elements takes 12—15 mins. and the accuracy is about 5 % to 10 %, *i.e.*, 0·01 % of the content. The results of continuous use under industrial conditions are described. F. S.

4237. Accuracy in Quantitative Spectral Analyses. H. Kaiser. *Zeits. f. techn. Physik*, 17. 7. *pp.* 227–239, 1936.—An exact mode of procedure is laid down for the quantitative spectral analysis of lead alloys containing small quantities of Sn, Sb and Cd. It is shown that the distribution of errors in a series of determinations by this procedure is according to the Gauss curve, and the magnitude of the average error in a single determination is measured. For instance, 63 determinations are made upon an alloy containing 0·57 % Sb and the average error corresponds to an error of 1·12 % in the determination of the Sb content. The maximum error in this series is 2·64 % An investigation is made into the contributions of photometer, photographic plate, spark production and inhomogeneity of samples to the total error. L. A. W.

4238. Spectroscopic Analysis of Alloy Steels. S. Mandelstam, W. Smirnow and W. Zehden. *Techn. Phys., U.S.S.R.* 3. 6. *pp.* 541–559, 1936. *In German.*—Two iron lines are chosen, bracketing a line of the element to be estimated. By means of a Wollaston prism two polarised spectra are produced vertically in register. By adjusting the analyser, intensities are equalised and from a calibration curve the percentage of foreign element is read off. The principle of photometry has the advantage of being workable with a few lines or even a single line, and consequently seems suitable for the light alloys. A 110/12,000-V transformer with output of 200 VA is used in conjunction with a capacity of 0·01μF, giving a spark length of 3 mm. Self-induction is 10^{-5} H. Time of estimation including calculation is 8–10 min. with an accuracy of 10–30 % for Cr, Ni, Si, W, V, Mo, Co, Mn. D. R. H.

4239. Infra-Red Spectra and Organic Chemistry. R. B. Barnes. *Rev. Sci. Instruments*, 7. *pp*. 265–271, *July*, 1936.—The application of the methods of infra-red spectroscopy to problems in organic chemistry is reviewed and the scope of the methods is indicated. Application to liquids has already solved many interesting problems. W. R. A.

See also Abstracts 3931, 3933, 3934, 3935, 3936, 3937, 3938, 3973, 4127, 4134, 4139, 4286, 4316, 4354.

VISION.

4240. Characteristics of the Eye with Special Reference to Road Lighting. P. J. Bouma. *Philips Techn. Rev.* 1. *pp*. 102–106, *April*, 1936.—Following a brief discussion on the way in which objects are seen on artificially-illuminated highways, the circumstances in which the eye is likely to fail are studied. The efficient or imperfect functioning of the eye is determined mainly by the visual acuity, the contrast sensibility, the richness of contrast and the speed of vision. The interconnection of these phenomena is discussed in reference to the following characteristics of the eye: Accommodation, diameter of pupil, chromatic and spherical aberration, astigmatism, adaptation, glare and the Purkinje phenomenon. AUTHOR.

4241. Comparison of the Energies of a Monochromatic Radiation and a Mixture Having the Same Colour. E. Haas. *Comptes Rendus*, 203. *pp*. 120–122, *July* 6, 1936.—The best possible colour match was made between one half of a photometric field illuminated by a monochromatic yellow (0·588μ) and the other half illuminated by a mixture of two monochromatic components (0·546 μ and 0·656 μ). A thermopile was then substituted for the eyepiece and the ratio of the energies of the two fields was determined and found to exceed 2. In this instance the author's question whether the energy ratio at colour match equals unity is answered in the negative. The author considers direct experiment preferable to an argument based on the luminosity function. W. S. S.

4242. Formation of Retinal Images. C. Lapicque. *Rev. d'Optique*, 15. *pp*. 121–145, *April*, 1936.—The distribution of illumination in the image of a distant point source of white light on the retina of an "ideal" eye of apparent pupil diameter 5 mm. is calculated allowing for diffraction, chromatic aberration and the relative luminosities of different wave-lengths in the spectrum. The results indicate that the sharpest image is obtained when the eye is accommodated to bring light from the source of wave-length 580 mμ into focus on the retina, but for accommodations not too different from the one indicated the image contains a central bright spot which is no larger than that of the diffraction pattern given by a monochromatic source (in focus). The validity of the assumptions made about the properties of the ideal eye are examined critically. The main deviation from the calculated image illumination is related to radial structure in the crystalline lens. W. S. S.

4243. Optical Structure of the Vitreous Humour. C. Lapicque. *Comptes Rendus*, 203. *pp.* 122–124, *July* 6, 1936.—By viewing an extended field of high and uniform brightness through a 100 μ dia. aperture at the eye, the fibres of the vitreous humour are revealed by the shadows cast on the retina. Concentrating attention on fibres located approximately midway between cornea and retina, the shadow system of a single fibre is seen to consist of two dark bands, following the contour of the fibre, within which the brightness is enhanced. It is estimated that the fibres have diameters lying between 50 and 100 μ. The shadow system observed can be reproduced in a model in which a cylindrical glass rod is immersed in a liquid of nearly the same refractive index and is illuminated by an aperture emitting monochromatic light so as to throw the shadow of the rod on a suitable screen. It is deduced from this model (*a*) that the fibres of the vitreous humour have a refractive index slightly greater than that of the surrounding liquid ; (*b*) that this difference of refractive index may be no greater than 0·03 % for just perceptible fibres, but must be of the order of 0·3 % for most of the fibres observed. W. S. S.

4244. Measurements of the Eye Pupil under Low Illuminations by Means of Infra-Red Photography. M. Nagel and A. Klughardt. *Zeits. f. Physik*, 101. 5–6. *pp.* 372–377, 1936.—Infra-red photographs of the eye pupil were made for one subject viewing an extended field of uniform brightness ranging from zero to 4·45 apostilbs. Over this range the pupil diameter varied from 8 to 6·2 mm. and was a linear function of the logarithm of the field brightness. A connection between the pupil reflex and the " power of orientation " (fixation ?) of the eye, is suggested. W. S. S.

X-RAYS.

4245. Form of the Compton Line. G. Burkhardt. *Ann. d. Physik*, 26. 6. *pp.* 567–584, *July*, 1936.—The form of the Compton line scattered by electrons bound to a nucleus is derived by treating the electrons as a packet of free electrons with a given distribution of momenta, the potential field being neglected except in so far as it determines the distribution of momenta. The calculation is carried out for the case of Ne deriving the momentum distribution in turn from the Thomas-Fermi statistical model, Schrödinger's H-like wave-functions for the different electron shells, and Hartree's self-consistent field model. The latter two methods give much the same form for the Compton line and this form agrees satisfactorily with the experimental result. The corrections necessary to allow for the nuclear field and the relativity correction are shown to produce small asymmetries and displacements of the maximum of the line, which are of the same order of magnitude for both corrections. W. S. S.

4246. X-Ray Scattering and Polarisation Field in Di-, Tetra- and Decahydronaphthalene. M. S. Joglekar. *Zeits. f. Physik*, 101. 5–6. *pp.* 398–404, 1936.—Debye-Scherrer diagrams were obtained for powdered naphthalene and the liquids di-, tetra- and decahydronaphthalene. For the liquids a single ring was obtained in each case, from the inner and outer limits of which the constants of the polarisation field in the liquid were deduced by a theory due to Krishnan and Rao. It is concluded that in passing from naphthalene to decahydronaphthalene there occurs a progressive diminution in the anisotropy of the polarisation field. W. S. S.

4247. Ionisation in Liquid Dielectrics. C. Bialobrzeski. *J. de Physique et le Radium*, 7. *pp.* 329–336, *Aug.*, 1936.—Deals with ionisation phenomena in liquid hydrocarbons under the action of X-rays, and the determination of the mobilities and coefficients of recombination of the ions. There are three kinds of ions, of which two are positive and the other negative. The mobility of the negative ions is intermediate between those of the positive ions. The relation between mobility μ and viscosity η is $\mu = A\eta^{-3/2}$. The application of dielectric liquids to the study of ionisation " bursts " under the action of cosmic rays is also discussed. E. R.

***4248. Mass-Absorption Coefficients of Cellophane, Al, Se, Ag, Cd, Sn, Sb and Te for Monochromatic X-Rays up to 10 Å. H. H. Biermann.** *Ann. d. Physik*, 26. 8. *pp.* 740–760, *Aug.*, 1936.—A description is given of an apparatus for the production of intense monochromatic X-rays on the wave-length region from 1·66 to 9·87 Å by the difference method of Küstner [see Abstracts 3847 and 3848 (1931)]. The high degree of spectral purity of the rays is tested. On account of the strong absorption by air at the wave-lengths used, the secondary emitter, difference filter, absorbers and ionisation chamber are all mounted in a container in which the air pressure is kept at the value for which the radiation produces maximum ionisation. The mass absorption coefficients of cellophane, Al, Se, Ag, Cd, Sn, Sb and Te are determined over the wave-length range mentioned. The $C\lambda^n$ law is closely obeyed in all cases. The results are compared with those of other workers. In particular, the lack of agreement with the observations of Jönsson are explained as due to secondary radiation from Jönsson's spectrometer crystals. The L-jumps between Se34 and U92 are deduced to within a few %, and the K-jump of Al is given. L. A. W.

4249. Lα Satellites for Elements 72, 73, 75, 83, 90 and 92. Yvette Cauchois. *Comptes Rendus*, 202. *pp.* 2068–2069, *June* 22, 1936. The discovery, measurement and identification of Lα satellites for the above elements are reported. D. H. F.

4250. X-Ray Spectrum of Rhenium. Yvette Cauchois. *Comptes Rendus*, 203. *pp.* 169–171, *July* 15, 1936.—The fine structure of the L-radiation of Re is studied in detail. Measurements of some 30 lines are given, and the term values are calculated. A. H.

***4251. Remeasurement of Uranium L-Lines. H. Claësson.** *Zeits. f. Physik*, 101. 7–8. *pp.* 499–508, 1936.—Making use of a curved crystal as a transmission grating and the same spectrometer as was employed in previous work [see Abstract 4960 (1933)] new measurements were made of known lines in the L-spectrum of U relative to the K-lines previously measured by the Tubus spectrometer. Measurements were also made of a number of quadrupole and weaker dipole lines not recorded hitherto. A. W.

4252. Intensity of X-Ray Spectral Lines of Heavy Elements. H. S. W. Massey and E. H. S. Burhop. *Cambridge Phil. Soc., Proc.* 32. *pp.* 461–470, *July*, 1936.—The intensities of X-ray spectral lines resulting from transitions between the K, L and M shells have been calculated using screened relativistic wave functions. The relativistic modifications are shown to decrease the $L\beta_3\beta_4$ doublet ratio but do not alter the $K\alpha_1\alpha_2$ and $K\beta_1\beta_3$ ratios, in agreement with experiment. The calculated intensities of the forbidden lines arising from quadrupole transitions are in good agreement with experiment. Lines due to $j = \frac{1}{2} \rightarrow j = \frac{1}{2}$ transitions arising from the magnetic dipole moment of the electron are found to be very weak, but the $L_1 \rightarrow K$ transition might just be observable for heavy elements. AUTHORS.

4253. Enhancement of Certain L- and M-Series X-Ray Satellite Lines by the Auger Effect. F. R. Hirsh, Jr. *Phys. Rev.* 50. *pp.* 191–197, *Aug.* 1, 1936.—Integrated relative energies for the satellites of $L\beta_1$ are measured by a photographic method. A marked change in relative intensity exists at $Z = 40$, which is to be explained by enhancement of the $L\beta_1$ satellites due to the Auger effect. The enhancement of M-series satellites by the Auger effect is discussed. The theory explains the almost identical frequency separations and nearly equal intensities observed for the satellite groups of the $M\alpha_1$ and $M\beta$ lines of Bi(83). Some experimental evidence of an intensity anomaly due to the Auger effect, for the satellites of $M\alpha_1$, is presented. AUTHOR.

4254. K-Radiation of Crystalline Boron. A. Hautot. *Comptes Rendus,* 202. *pp.* 2138–2140, *June* 29, 1936.—The K-radiation of crystalline boron was photographed for temperatures of the boron of approximately 1800° and 600° Abs. At 1800° Abs. the spectrum consisted of a continuous band extending over about 8·5 Å and having a single maximum of intensity near the short-wave end of the band. At 600° Abs. the band was considerably wider (13 Å) and exhibited four sharp maxima of intensity. The difference is ascribed to the fact that at the higher temperature the L electrons are free within the crystal lattice, whilst at the lower temperature they are bound to the lattice. The observations are linked up with the known very large increase in electrical conductivity of boron with rise of temperature. W. S. S.

***4255. Effects of Chemical Composition on X-Ray Lines. H. H. Roseberry and J. A. Bearden.** *Phys. Rev.* 50. *pp.* 204–208, *Aug.* 1, 1936.—The influence of chemical combination with oxygen on the width, index of asymmetry and separation and ratio of peak intensities of the α-doublet of the elements Ti, Cr, Fe and Zn of the K-series emission lines has been studied with a double crystal spectrometer. The widths of the α-lines were increased 3 to 35 % and the β-lines were increased 4 to 30 % except in two cases, namely, that of the $K\alpha_1$-line of TiO_2, whose width decreased 3 %, and that of the β-lines of the oxides of Mn, whose width remained the same as that of the pure metal. No effect of chemical composition on the widths of the γ-lines was observed. The $\alpha_1 \rightarrow \alpha_2$ separations were unaffected by chemical composition. The asymmetries of all the lines were unaffected with the exceptions of the α-lines of TiO_2 and the $K\alpha_1$- and the β-lines of MnO and Mn_3O_4. The ratios of peak intensities of the α-lines were affected by changes of width caused by chemical composition such that the ratio of areas remained 2 : 1.

AUTHORS.

***4256. Fine Structure in the K X-Ray Absorption Edge of Gallium. W. W. Mutch.** *Phys. Rev.* 50. *pp.* 197–201, *Aug.* 1, 1936.—The absorption of X-rays by a Ga foil in the region extending from the main K absorption edge of Ga towards shorter wave-lengths for a distance of about 250 V has been investigated by the ionisation method. The absence of any extended fine structure at room-temperature is confirmed. The temperature of the Ga has been reduced to − 67° C. and − 140° C., and a progressive appearance of extended fine structure has been noted as the temperature decreased. Checks have been made to prove the validity of the conclusions. The results of the investigation are presented in graphical and tabular form. A value of 1192·5 X.U. for the wave-length

of the main K absorption edge of Ga is determined. This value is believed to be more accurate than the value of 1190·2 X.U. found in most tables.
AUTHOR.

4257. Fine Structure of X-Ray Absorption Edge of Gallium. R. Smoluchowski. *Phys. Rev.* 50. *pp.* 201–203, *Aug.* 1, 1936.—The fine structure of X-ray absorption edge of gallium is calculated theoretically on the basis of Kronig's theory. A method given by the author in a previous paper of calculating the fine structure in complicated crystals is applied for the first time to a non-cubic crystal (orthorhombic-pseudo-tetragonal). A quantitative comparison with experimental results shows a good agreement. AUTHOR.

4258. Fine Structure of K X-Ray Absorption of Metallic Nickel. T. Hayasi. *Tohôku Univ., Sci. Reports,* 25. *pp.* 1–10, *April,* 1936. *In German.*—With a Johansson spectrometer the K absorption edge in metallic Ni is found to have two steps, and the absorption intensity in the long-wave step is about half that in the short-wave one. A region of weaker absorption was found to the short-wave side of the short-wave step. The K absorption of Ni Cu was found to have the same fine-structure. A. C. M.

4259. Diffraction of X-Rays by Diamond. Part II. P. P. Ewald and H. Hönl. *Ann. d. Physik,* 26. 8. *pp.* 673–696, *Aug.,* 1936.—The problem of the charge distribution in a "linear crystal," *i.e.*, an endless linear chain of atoms, is attacked from the point of view of wave-mechanics. A solution is obtained for a chain consisting of a given number of atoms and this is extended to the case of the "linear crystal." The results obtained can be applied to the study of a real crystal and this is done in the case of diamond. It is found that the results on the diffraction of X-rays by diamond, given by the authors' previous investigation [see Abstract 1738 (1936)], are not far from the truth. J. T.

See also Abstracts 3952, 3968, 4124, 4137, 4139, 4176, 4275, 4389, 4391, 4416.

HEAT.

CALORIMETRY.

***4260. Specific Heats of Non-Electrolytes in Solution : Influence of Dielectric Constant of Solvent upon State of Vibration of Solute Molecules. K. Bennewitz and L. Kratz.** *Phys. Zeits.* 37. *pp.* 496–511, *July* 15, 1936.—A differential calorimetric method, based on that of Heydweiller, is described for comparing to an accuracy of 0·02 % the specific heat of a solution with that of its solvent ; the platinum heating coils employed serve simultaneously as resistance thermometers. Results for solutions of LiCl and CsCl agree with previous determinations. For solutions of non-electrolytes it has previously been assumed that the specific heats of solvent and solute are additive, subject only to an increase in the molar specific heat of the solute of 3–6 cal./deg. due to additional degrees of freedom acquired thereby on passing into solution. The authors find such an increase in dilute aqueous solutions of urea and glycerol, but the increase is much greater in aqueous solutions of hydroquinone and dioxane and of the sugars and is dependent upon concentration. In solutions in non-aqueous solvents, the increase is less the lower the dielectric constant K of the solvent, solvents ranging in K from water ($K = 80$) to dioxane ($K = 2·2$) being studied. These results are interpreted in terms of the influence of K on the vibration-frequencies of the solute molecules and should be further explained if the same systems were investigated for Raman effect. L. V. C.

***4261. Thermal Properties of Hydrogen and Deuterium at Low Temperatures. A. Eucken.** *J. de Physique et le Radium,* 7. *pp.* 281–288, *July,* 1936.—New apparatus for the measurement of the specific heat and other thermal properties of hydrogen in the gaseous, liquid and solid state is described. The results obtained for the heat of rotation of H_2, HD and D_2 are given, and the results of measurements of a number of other properties of H_2 and D_2 are tabulated. It is shown that the considerable differences in the properties of the two isotopes can be explained by the existence of molecular vibrations, at the zero point, which are relatively intense and largely anharmonic. C. J. B. C.

***4262. Adiabatic Calorimeter. W. Weinrich and H. Gaspari.** *Indust. & Engin. Chem.* (*Analytical Edition*) 8. *pp.* 307–310, *July* 15, 1936.—A sensitive adiabatic calorimeter is described in which the rate of O_2 absorption and the rate of temperature change due to the heat of reaction of finely divided substances with O_2 are measured. A differential thermopile and a photoelectric relay maintain adiabatic conditions ; an electronic relay and an electrolytic cell make possible the automatic control of O_2 pressure. For certain samples of bituminous coal at one atmosphere pressure and at 50° C. initial temperature, O_2 absorption and temperature rise are nearly linear functions of time and one may be predicted from the other with considerable accuracy. AUTHORS.

See also Abstracts 4284, 4290.

CONDUCTION.

4263. Application of the Heaviside-Bromwich Operational Method to the Solution of a Problem in Heat Conduction. A. Luikov. *Phil. Mag.* 22. *pp.* 239–248, *Aug.*, 1936.—For the solutions of heat conduction problems in which the surface temperature varies with time the contour integral method of Carslaw has certain advantages over the method of Duhamel. It has limitations, however, in that the form of the integrand is assumed and not derived. The present work shows that the application of the operational method of Heaviside, as developed by Bromwich, leads also to a contour integral, and has the advantage that the form of the integral is obtained directly from the operational equation. The cases dealt with are: heat conduction in a radiating sphere; in a plane slab, the surface being maintained at a temperature $U = U_0(1 - e^{-ct})$; and in a finite rod, initially at a uniform temperature, having its ends cooled to zero and radiation from the surface. R. W. P.

4264. Determination of Accommodation Coefficients from Temperature Drop Effects. H. S. Gregory. *Phil. Mag.* 22. *pp.* 257–265, *Aug.*, 1936.—In the author's earlier determination of the thermal conductivity and accommodation coefficient of a gas an equation has been used which is based on an assumption made by Smoluchowski which is strictly applicable to monatomic gases only. A more general form of the equation is now developed from which the accommodation coefficient can be derived in terms of the known experimental values of the specific heats of gases. This no longer depends on a numerical factor applicable to monatomic gases alone. Values of the new factor are tabulated for a number of common gases. These are invariably lower than the value previously used, a maximum difference of about 30 % occurring with NH_3. R. W. P.

4265. Thermal Conductivities of Mixtures of Metal Spheres and Oils. K. Bartens. *Forsch. IngWes.* 7. *pp.* 174–176, *July–Aug.*, 1936.—The concentric cylinder method is used to determine the thermal conductivities of mixtures of solid spheres and fluids. The effect of convection is eliminated by extrapolation to zero temperature difference. For lead-shot in castor oil the conductivity of the mixture increases as the diameter of the shot is decreased. Mixtures of 3 mm. spheres of Pb, steel, Cu and glass in the oil and in air are also studied. Castor oil has a thermal conductivity of 0·00042 c.g.s. units, and when mixed with glass, lead, steel and copper it is increased to 0·0008, 0·0017, 0·0025, and 0·0036, respectively. Since the respective conductivities of the solid materials are 0·0017, 0·067, 0·10 and 0·89 it appears that there is an appreciable thermal resistance at the solid-oil interface, which greatly diminishes the influence the conductivity of the solid has on that of the mixture.

R. W. P.

See also Abstract 4267.

CONVECTION.

4266. Heat Transfer by Natural Convection from Horizontal Cylinders to Diatomic Gases. R. Hermann. *Forsch. IngWes.* 7. *V. D. I. Forschungsheft No.* 379. [24 *pp.*] *July–Aug.*, 1936.—The results of earlier measurements of heat transfer by natural convection from horizontal wires and tubes are examined. The dependence of the Nusselt number (Nu) on the dimensionless factor Te, the ratio of the temperature difference between the surface and the enclosure to the enclosure temperature in °K., has been demonstrated for the first time. This is especially large in the region of small Grashoff numbers (10^{-4} to 10^{1}) where Nu increases by about 22 % as Te increases from 0 to 1. A theoretical analysis shows that an increase of 19 % is to be anticipated. The dependence of Nu on Pr and Gr is dealt with in a similar way. A solution is given for the equation of the limiting laminar film around the horizontal cylinder which leads to Nu being directly proportional to $Gr^{0\cdot25}$. The temperature and velocity fields around the cylinder are determined and compared with existing data. The cylindrical case is also compared with that of a vertical plane, and the schlieren method is applied to both cases to determine the critical conditions at which turbulence occurs. For both, the critical velocity of the laminar film gives a Reynolds number of about 300. R. W. P.

4267. Transmission of Heat Past a Circular Cylinder in a Transverse Current of Fluid. G. Kroujiline. *Techn. Phys., U.S.S.R.* 3. 4. *pp.* 311–320, 1936. *In French.*—The theory evolved for the heat distribution around a solid body when placed in a current of fluid flowing parallel to its length [see Abstract 2540 (1936)] leads to a similar expression when the body is placed so that the flow is transversal. The boundary layer immediately touching the solid body is discussed in detail. After a full theoretical discussion the expression derived is evaluated and the results are compared favourably with those obtained experimentally by Kroujiline and Schwab. S. G. B.

4268. Similarity of Temperature and Velocity Fields in Turbulent Flow. A. Guchmann. *Techn. Phys., U.S.S.R.* 3. 4. *pp.* 295–310, 1936. *In German.*—The two-dimensional turbulent motion of a compressible fluid at high speeds over heated (or cooled) surfaces is considered, the density fluctuations due to the turbulent mixing being neglected, and the specific heat taken as constant. The equations of motion and energy are simplified in accordance with boundary-layer theory, and it is shown that in the absence of a pressure gradient, the temperature, when increased by the thermometric equivalent of the kinetic energy ($u^2/2J\, g\, c_p$), will have a similar distribution to the velocity. In the presence of a pressure gradient (as for pressure flow between parallel walls) this cannot be the case, a necessary condition being that the kinetic energy per unit volume ($\frac{1}{2}\rho u^2$) should be constant over a cross-section. Nevertheless, the author considers that the condition may be considered fulfilled in high-speed turbulent flows to a " sufficient " accuracy, and finds the relation between the resistance coefficient and the Nusselt number, which he found well substantiated by experiments on high-speed flow in circular pipes. It is pointed out that (because of the " laminar sub-layer " near the walls) it is assumed that the Prandtl number is nearly unity ; a modification when this is not the case is mentioned. S. G.

DILATATION.

4269. Coefficients of Expansion and Allotropy of Barium and Calcium. P. G. Cath and O. L. v. Steenis. *Zeits. f. techn. Physik,* 17. 7. *pp.* 239–241, 1936.—The coefficients of linear expansion of Ba and Ca are determined between 0 and 300° C. in a current of argon. In this temperature range Ba gives values from $1\cdot7$ to $2\cdot1 \times 10^{-5}$, the behaviour depending to a marked degree upon the previous thermal treatment. A halt is observed in the cooling curve of this metal at 390° C., indicating transition between different modifications. With Ca a similar behaviour (but less pronounced than with Ba) is observed, the coefficient of linear expansion below 300° C. being about $2{\cdot}2 \times 10^{-5}$. L. A. W.

4270. Thermal Expansion of Beryllium. E. A. Owen and T. L. Richards. *Phil. Mag.* 22. *pp.* 304–311, *Aug.*, 1936.—The thermal expansion of Be, the purity of which was 99·8 %, was measured by the X-ray method along and perpendicular to the hexagonal axis over a range of temperature from 20° to 550° C. Its structure remained close-packed hexagonal over the whole range of temperature investigated. The mean parameters of Be at 20° C. are : $a = 2{\cdot}2812_4$ Å and $c = 1{\cdot}5682_1$, each to an accuracy of $\pm\ 0{\cdot}0003$. The thermal coefficient of expansion both along and perpendicular to the hexagonal axis increases with temperature, the coefficient parallel to the axis increasing less rapidly than that perpendicular to the axis. The axial ratio thus decreases with rise of temperature. At 50°, 100°, 200°, 300°, 400°, and 500° C. the values of $\alpha_{\perp}$ are 13·7, 14·4, 15·9, 17·6, $19{\cdot}5_5$, and $21{\cdot}5 \times 10^{-6}$, and those of $\alpha_{\parallel}$ are 11·1, 11·5, 12·2, 13·1, 14·2, and $15{\cdot}8 \times 10^{-6}$. Values are also included of the mean linear coefficient of expansion of Be, and the results, compared with the only values previously published, are found to be in satisfactory agreement over the greater part of the temperature range covered by the observations. AUTHORS.

See also Abstracts 3958, 3980.

MELTING AND BOILING POINTS.

4271. Cryoscopy and Ebullioscopy of Fatty Acids. H. N. Brocklesby. *Canad. J. of Research*, 14. *Sect. B. pp.* 222–230, *June*, 1936.—By the ebullioscopic method and in benzene solution, saturated fatty acids show, with increasing carbon content, a decreasing degree of association up to lauric acid, after which it remains more or less constant. Unsaturation is shown to decrease the extent to which the molecules of fatty acids of the same carbon content associate. The degree of association of oleic acid in several solvents has also been determined. [See following Abstract.] AUTHOR.

4272. Molecular Weights of Polymerised Esters. H. N. Brocklesby. *Canad. J. of Research*, 14. *Sect. B. pp.* 231–236, *June*, 1936.—When a value of K that allows for the effect of the solute on the dissociation of the solvent is used, raw linseed oil shows normal values for the molecular weight when determined cryoscopically or ebullioscopically in a number of diverse solvents. Similarly, polymerised oils and esters show identical molecular weights in different solvents when determined either cryoscopically or ebullioscopically. The data indicate that polymerised esters of unsaturated fatty acids cannot be assumed to be associated. [See preceding Abstract.] AUTHOR.

4273. Potassium-Cæsium Equilibrium Diagram. E. Rinck. *Comptes Rendus*, 203. *pp.* 255–257, *July* 20, 1936.—Twice re-distilled commercial K (*m.pt.* 63·6° C.) and Cs prepared from the chloride (*m.pt.* 28·4° C.) are used for synthesis of the alloys. Thermal analysis shows coincident minima on liquidus and solidus at −37·5° C., exactly at an equimolar K : Cs ratio. Electrical conductivity-composition curves show a valley, with point at the same composition, so that there is no evidence for a KCs compound. Heating curves for alloys held at − 20° C. for 24 hr. or more showed no trace of a compound K_2Cs (by analogy with Na_2Cs). [See also Abstracts 2630 (1935), and *Gazz. Chim. Ital.* 65. *p.* 1226, 1935.] D. R. H.

4274. Relation between Boiling Points and Critical Temperatures and Pressures. Chu-Yao Chen and Chao-Lun Tseng. *Chem. Eng. China, J.* 3. *pp.* 110–112, *June*, 1936. *In English.*—It is pointed out that the formulæ of Avogadro-Guldberg, Guldberg-Guye, Groshan, Herz, Prud'homme, Soebel, and Ferguson involve only temperatures, whereas an inspection of the physical constants of the principal gases shows that for high boiling temperatures both the critical temperatures and critical pressures are high. Further, the values of the critical temperatures of various liquefied gases increase more rapidly, while the critical pressures increase less rapidly than the boiling points, when all are compared on the absolute scale. A linear relationship is then constructed, $T_b = aT_c + bP_c$, where T_b, T_c and P_c are the absolute values of the boiling point, critical temperature and critical pressure respectively, and the empirical formula $T_b = 0{\cdot}53796\ T_c + 0{\cdot}23755\ P_c$ is found to hold good for 18 gases. From a table of comparative values given by the various formulæ, the above expression is seen to afford the least error from the experimental results. H. H. Ho.

***4275. Cryogenic Laboratory of the California Institute of Technology. Part II. A. Goetz.** *Rev. Sci. Instruments*, 7. *pp.* 307–318, *Aug.*, 1936.—In continuation of Part I [see Abstract 3935 (1935)] the He circuit with its auxiliaries, the method of purification of He, its distribution and its storage are described. For the performance of low temperature experiments separate " stations " are provided, consisting each of a ventilated compartment which is connected with the necessary gas and vacuum systems. Each station contains a liquefier as an integral part of the particular apparatus designed for one type of experiment. The general design of these stations and the detail of the construction of one built especially for X-ray spectroscopy at low temperatures is described. The equipment for potentiometric measurements is centralised; its arrangements, the thermometric methods and the system of communication between stations and potentiometers is described. AUTHOR.

4276. Rate of Evaporation of Liquids in Moving Air. S. I. Skljarenko and M. K. Baranajew. *Acta Physicochimica*, 4. 6. *pp.* 873–888, 1936. *In German.*—The hitherto divergent results for the relationship of the rate of evaporation of a liquid to the velocity of the air moving across its surface are discussed, and an experimental method is outlined with results and theory to determine the relationship of the various factors concerned. It is shown that the rate of evaporation of the liquid (if pure) both with laminar and turbulent flow across its surface depends upon and can be determined by the rate of diffusion of the vapour of the liquid in moving air. An expression is derived showing this connection. S. G. B.

***4277. Precision Melting-Point Apparatus. E. B. Hershberg.** *Indust. and Engin. Chem.* (*Analytical Edition*) 8. *pp.* 312–313, *July* 15, 1936.—From a consideration of types of apparatus and of heating, medium of heat transfer, and thermometers, it was concluded that a mechanically stirred and electrically heated cyclic liquid bath was best. Further, in the ideal apparatus there should be a zone adiabatic relative to the external surroundings, and it should be possible to immerse the mercury column of the thermometer completely without requiring excessively long capillary tubes. These details are closely approached in the apparatus now fully described with accompanying photograph and illustrative diagram, which is suitable for the conventional short Anschütz enclosed-scale thermometers. H. H. Ho.

See also Abstracts 3932, 3950, 4261, 4421.

TEMPERATURE, MEASUREMENT OF.

4278. Evaluation of the Thermodynamic Scale. W. Jacyna. *Acta Physica Polonica*, 4. 3. *pp*. 243–268, 1935. *In French.*—The paper commences with a historical review of the work on the definition of temperature independent of the properties of the thermometric substance. The subject is then critically examined under the following sections: (1) Empirical temperature and the thermodynamic scale. (2) Practical temperature as measured by the gas thermometers at constant volume and at constant pressure. (3) Fundamental properties of the thermodynamic scale. (4) Methods for evaluation of the absolute temperature. It is pointed out that the thermodynamic scale has not yet been realised in the form of an empirical scale, but that it may be evaluated to-day with sufficiency accuracy from the experimental data afforded by investigations on He, which is the best thermometric substance as yet examined. (5) The characteristic equation from thermodynamic theory. (6) The general thermodynamic relation. (7) Limiting conditions for $p = 0$ at temperature $t_0 = 0°$ C. (8) Extrapolation methods. (9) Evaluation of ψ_0 (absolute temperature), which is found to be 273·22° K. A comprehensive Bibliography completes the paper. H. H. Ho.

See also Abstracts 3980, 4277.

THERMOCHEMISTRY.

4279. Heats of Mixture of Anhydrous Sulphuric and Nitric Acids. R. Dalmon. *Comptes Rendus*, 203. *pp*. 250–252, *July* 20, 1936.—The heats of mixture, when varying amounts of HNO_3 are added to H_2SO_4, are determined calorimetrically. The heat liberated is proportional to the quantity of HNO_3 added. Comparing the results with Chédin's investigations of Raman spectra [see Abstract 2235 (1936)], it seems that the heat liberated is closely connected with the amount of nitric anhydride formed in the mixture. C. J. B. C.

4280. Induction Period and Ignition Temperature of Methane-Oxygen Mixtures. H. Sachsse. *Zeits. f. phys. Chem.* 33. *Abt.B.* 3. *pp*. 229–241, 1936.—A dynamical method for measuring the induction period of a mixture of CH_4 and O_2 (62 : 38) is described. The period determined thereby, as also by a statical method, is 0·1–0·01 sec. at 850°–950°, and 3–6 sec. at 500°. It is then shown that this period and its variation with temperature can be calculated on the basis of Norrish's O-atom chain theory for the combustion, while the ignition depends on the number of O atoms in thermodynamic equilibrium. C. A. S.

See also Abstracts 4139, 4215.

THERMODYNAMICS.

4281. Derivation of the Equation of State for a Degenerate Relativistic Gas. R. Peierls. *Roy. Astron. Soc., M.N.* 96. *pp*. 780–784, *June*, 1936.—Another proof of this equation of state is given showing that the equation is independent of the shape of the region enclosing the gas. The electron is assumed to be "enclosed" within the region by a suitable potential field. The size of the region and the energy of the electron must be so adjusted that the uncertainty principle is obeyed. This is ensured by assuming that the energy-level of the electron has a great number of other levels below it. The difficulty of the escape of electrons through the potential barrier is discussed and shown to be unimportant. G. C. McV.

4282. Critical State in the Light of a New General Equation of State. R. Plank. *Forsch. IngWes.* 7. *pp.* 161–173, *July-Aug.*, 1936.—An attempt is made to bring the continuity theory and the two-phase theory into agreement within the critical range. After a survey of the older work the various proposals for the continuation of the vapour-pressure curve are dealt with. It is shown that the point of inflection in the isotherm in the pressure-volume diagram marks an unstable state region between the critical point and the "absolute vaporisation point." By extending the proposal of Clausius and Wohl a new equation of state of the 5th degree in V is obtained. This equation gives good agreement with observed thermal behaviour for values of V equal to or greater than the critical volume, and often up to three times the criticial pressure, for both normal and associated substances. R. W. P.

4283. Quantum Theory of the Non-Ideal Gas. Part I. Deviations from Classical Theory. G. E. Uhlenbeck and E. Beth. *Physica*, 3. *pp.* 729–745, *Aug.*, 1936. *In English.*—In §1 the connection is shown between the virial coefficients of Kamerlingh Onnes and the probabilities to find pairs, triples and so on of molecules near each other (eqs. (4) and (6)). A discussion is given of the question for which temperature region these probabilities can be expressed by the classical Boltzmann factors. This is the case when $\lambda = h/\sqrt{mkT}$ is small compared with the molecular "diameter." In §2 a development of the second virial coefficient B(T) valid for high temperatures is obtained (eqs. (13), (14)). The first correction to the classical expression for B(T) has been evaluated for He, using the Lennard-Jones potential for the intermolecular forces. For $T < 75°$ the correction becomes quite appreciable (Table I). In §3 an exact expression for B(T) is given (eq. (21)), which in §4 has been applied to determine B(T), when the molecules may be represented by elastic spheres. Eqs. (27) and (29) and Fig. 1 show for this case the behaviour of B(T) for low and high temperatures. AUTHORS.

4284. Entropy of Water and Third Law of Thermodynamics. Heat Capacity of Ice from 15° to 273° K. W. F. Giauque and J. W. Stout. *Am. Chem. Soc., J.* 58. *pp.* 1144–1150, *July*, 1936.—The heat capacity of ice is measured between 15 and 273° K. It has previously been shown by Giauque and Ashley that a discrepancy exists between the spectroscopic value of the entropy and the $\int_0^T C_p\, d \log T$ for water. The purpose of the present investigation is to make an accurate determination of the discrepancy. With the assistance of the well-known values for the heats of fusion and vaporisation of water it is found that the $\int_0^T C_p\, d \log T = 44\cdot28 \pm 0\cdot05$ cal./deg./mol. for H_2O (gm.) at one atmosphere and 298·1° K. The spectroscopic value is 45·10 leading to a discrepancy of 0·82 cal./deg./mol. This is in excellent agreement with the theoretical discrepancy 0·806 calculated by Pauling on the assumption of random orientation of hydrogen bond directions in ice. Experiments are described in which ice is cooled slowly or rapidly to low temperatures or allowed to stand for long periods of time at low temperatures. No difference in the thermal properties of ice is observed in these experiments. AUTHORS.

4285. Limiting High-Temperature Rotational Partition Function of Non-Rigid Molecules. L. S. Kassel. *J. Chem. Phys.* 4. *pp.* 493–496, *Aug.*, 1936.—The entropy of methanol and the equilibrium constant for methanol synthesis are calculated for two molecular models, one of which rotates freely about the CO bond, while the other possesses a torsional oscillation of frequency 700 $cm.^{-1}$ about that bond. The latter model is indicated by spectroscopic evidence and gives an entropy in close agreement with the third law value and an equilibrium constant close to the mean of the widely scattered experimental results. The former model is supported strongly by valence theory; it can be made to agree with the third law entropy by assuming a zero-point entropy of R log 3, and its rather poor agreement with experimental equilibrium data is not conclusive evidence against it. The true equilibrium constant probably lies between these two calculated values, or at worst slightly beyond one of them. [See also Abstract 2302 (1936).] AUTHOR.

4286. Effect of Rotational Distortion on Thermodynamic Properties of Water and Other Polyatomic Molecules. E. B. Wilson, Jr. *J. Chem. Phys.* 4. *pp.* 526–528, *Aug.*, 1936.—The classical mechanical expression for the energy of a non-vibrating, rotating polyatomic molecule is obtained which includes a correction term arising from the centrifugal distortion of the molecule caused by the rotation. Since the rotational partition function closely approaches the classical phase integral for room temperatures or higher, the latter is used to calculate the effect of centrifugal distortion on the entropy, heat capacity and free energy. The correction terms $-\rho RT^2$, $2\rho RT$ and $2\rho RT$ must be added to F, S and C_v, respectively. ρ is a constant characteristic of each molecule. The values of ρ calculated are: H_2O, $2\cdot04\times10^{-5}$; H_2S, $1\cdot62\times10^{-5}$; NH_3 $1\cdot45\times10^{-5}$; CH_4, $1\cdot72\times10^{-5}$; C_2H_4, $0\cdot79\times10^{-5}$. For water this correction amounts to approximately ½ % of the heat capacity at the boiling point, or $+0\cdot032$ entropy unit. AUTHOR.

4287. Thermodynamic Properties of Phosphorus Compounds. T. F. Anderson and D. M. Yost. *J. Chem. Phys.* 4. *pp.* 529–530, *Aug.*, 1936.—With Raman spectrum, electron diffraction and existing equilibrium data the standard virtual entropies of P(*s*, white), $P_4(g)$, $PCl_3(g)$, $PCl_3(l)$, $PCl_5(g)$, and $PCl_5(s)$ are calculated to be 10·55, 66·88, 74·7, 52·8, 87·7, and 40·8 cal./deg. respectively. The corresponding standard free energies of formation are calculated to be (0), 5850, − 64,650, − 63,570, − 72,540 and − 77,950 cal., respectively. AUTHORS.

4288. Criticism of the So-called "Internal Thermodynamics." Z. Richtmann. *Zeits. f. Physik*, 101. 9–10. *pp.* 649–656, 1936.—The author shows that the so-called internal thermodynamics investigated by Njegovan [see Abstracts 2652 and 5114 (1935)] depend upon a misinterpretation of certain physical constants. The extension of the entropy conception, for example, is in contradiction with the second law of thermodynamics. Further, the faulty integration of the derived extensions of the laws relating to phenomena, give invalid formulæ, which, are shown by examples to be contrary to experience. The qualitative kinetic explanation which accompanies the mathematical deductions, is also shown to be contradictory to the fundamental principles of both the classical and quantum theories. H. H. Ho.

4289. Specific Thermodynamic Properties of Aqueous Solutions of Uni-Univalent Electrolytes. E. A. Guggenheim. *Phil. Mag.* 22. *pp.* 322–336, *Aug.*, 1936.—In previous papers [see Abstract 1745 (1935)] a theory was described which enabled the osmotic and activity coefficients for aqueous solutions of electrolytes to be calculated. The theoretical calculations are now compared with recent freezing-point and e.m.f. measurements. Agreement is very satisfactory up to an ionic strength of 0·1, but beyond this concentration the theory, in some cases, rapidly becomes inaccurate. C. J. B. C.

See also Abstracts 3942, 3950, 4038, 4098, 4261, 4274, 4278.

VAPOUR PRESSURE.

4290. Vapour Pressure of Deuterium Water from 20° to 230° C. F. T. Miles and A. W. C. Menzies. *Am. Chem. Soc., J.* 58. *pp.* 1067–1069, *July*, 1936.—The vapour pressures of D_2O are compared with those of ordinary water in the range 20 to 230° C. The vapour pressures are identical at about 224° C. The differences of the latent heats of vaporisation are evaluated approximately from the changes of vapour pressure over the same temperature range. AUTHORS.

4291. Vapour Pressures of Saturated Aqueous Solutions. E. J. Roehl. *Am. Chem. Soc., J.* 58. *pp.* 1291–1292, *July*, 1936.—The vapour pressures for the saturated aqueous solutions of monoammonium acid phosphate are determined over a temperature range of from 19 to 90° C.; and for the diammonium acid phosphate from 19 to 55° C. Empirical equations are derived to express the data. On plotting the data and all the data possible to locate in the literature for saturated aqueous solutions as log P against 1/T, it is found that the curves are all straight lines and all parallel to the curve for water. At present there seems to be no explanation for this unexpected result. AUTHOR.

See also Abstract 3932.

ACOUSTICS.

4292. Applications of the Continuity Equation of the Energy in Acoustics. B. P. Konstantinow and I. M. Bronstein. *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 630–640, 1936. *In German.*—An equation for the energy density of the perfect gas is discussed, which is suitable for application in a particularly convenient form. The equation ultimately derived, enables the propagation of sound to be described in a static inhomogeneous medium. Once more it is established that sound waves are propagated with adiabatic velocity, because such disturbances proceed sufficiently slowly. Problems involving additions of the second order are considered, and particularly in connection with the determination of the following magnitudes; density and flow of energy; sound pressure and average temperature increase in the sound field. In this respect, the necessity is proved for the careful testing of the usually accepted data for these quantities. The paper is mainly mathematical. H. H. Ho.

4293. Mechanical Vibrations at Radio Frequencies. R. C. Colwell and L. R. Hill. *Acoustical Soc. of America, J.* 8. *pp.* 60–61, *July,* 1936.—The magnetostriction property of nickel is used to vibrate Chladni plates at high frequencies. Rods of nickel from 3 cm. to 30·5 cm. are used and the frequency is found to be 252·7 *l*, where *l* is the length of the rod in cm. Diagrams show the arrangements for producing the vibrations and the figures obtained in sand upon glass or brass plates of a few sq. cm. area. The vibration increases with the temperature to a maximum at 200° C., but entirely disappears at 280° C. The effect cannot be obtained with Fe or Co because of the " Villari reversal " as shown by a diagram. H. M. B.

4294. Hot-Wire Location of Nodes in Stationary Waves. O. Tugman. *Rev. Sci. Instruments,* 7. *pp.* 287–288, *July,* 1936.—A platinum wire, 5μ dia., electrically heated, is used to explore the sound field in a metal tube in which stationary waves are generated by a diaphragm fitted to one end driven by a valve oscillator. The nodes are located within 1 mm., which, for a wave-length of 30 cm., allows the velocity of sound in gases to be obtained with good accuracy, given the frequency of the oscillator. An unexpected effect reported is a slight increase in the temperature of the wire round the nodes. K. M. C.

4295. Supersonic Velocities in Organic Halogen Compounds. S. Parthasarathy. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 519–522, *June,* 1936.—The paper gives supersonic velocities at about $7 \cdot 32 \times 10^6$ c./s., and adiabatic compressibilities calculated therefrom, in 15 halogen substituted compounds, of both the aliphatic and aromatic series. It is found in general, from a consideration of the results, that (1) the introduction of a heavier atom lowers the acoustic velocity, and (2) the presence of a double bond—or unsaturation—favours the lowering of the velocity. [See Abstract 3275 (1936).] AUTHOR.

4296. Resonance Curves for a Quartz Oscillator Immersed in Liquids. S. Parthasarathy. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 544–553, *June,* 1936.—Each curve is characteristic of the liquid and is resolved one from another very clearly only on the lower frequency region of the curve. The order of resolution observed is the order of the viscosities of the liquids. A greater number of diffraction orders are observed, not at the resonance of the crystal, but at a point of lower frequency, corresponding to the region of clear resolution of the resonance curves. The effects of damping, viz., (1) a shift in frequency and (2) flatness of the resonance curve are observed and recorded. The range and sharpness of resonance are compared (a) as between different liquids of different damping coefficients at a given frequency, and (b) in one liquid but at different frequencies (higher harmonics). For condition (a) the range extends, while the sharpness diminishes, for highly viscous liquids, while for condition (b) the sharpness increases with diminished range at higher frequency.

AUTHOR.

4297. Diffraction of Light by Ultrasonic Waves. Part II. S. Parthasarathy. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 594–606, *June*, 1936.—With sound of $\lambda\lambda$ 0·0651 and 0·0501 mm. in liquid, light is found to be reflected in accordance with Brillouin's formula $m\lambda = 2\lambda^* \sin \theta$. The formula is satisfied with different values for m, λ and λ^*. Further, confirmation is obtained by the verification of the relation between the incident and the reflected angles, when the reflected beam moves through twice the angle of rotation of the reflecting surface. Photographs of reflection of the first, second and third orders for some prominent Hg lines are reproduced. It is made out clearly that transmission (Raman-Nath's theory) and reflection (Brillouin's theory) are two separate phenomena, superposed on each other, in the case of diffraction of light by h.f. sound waves. Remarkably enough, the treatment for diffraction by both the methods leads to the same formula, which enhances the difficulty of separating out the intensities due to each cause. [For Part I see Abstract 3771 (1936).]

AUTHOR.

4298. Mechanism of Oscillations of a Quartz Plate in Fluids. H. E. R. Becker. *Ann. d. Physik*, 26. 7. *pp.* 645–658, *Aug.*, 1936.—In a previous paper [see Abstract 1777 (1936)] it was concluded that when a quartz plate is oscillating in a liquid, the liquid separates from the face of the plate during part of the period. Investigations carried out by four different methods now show that for pressure amplitudes up to 0·3 atmosphere no such separation occurs. The non-harmonic oscillations are not observed in the case of a freely suspended quartz plate and are attributed to the effect of the plane electrode on which the plate usually rests and which gives rise to a certain amount of " chatter."

A. W.

4299. Sonic Activation in Chemical Systems: Oxidations at Audible Frequencies. E. W. Flosdorf, L. A. Chambers and W. M. Malisoff. *Am. Chem. Soc., J.* 58. *pp.* 1069–1076, *July*, 1936.—Quantitative studies of the oxidation of water and of $NaHSO_3$ and NaCl in aqueous solution by cavitation produced at audible frequencies are carried out. The data indicate that the oxidations are accomplished through the production of activated O, in association with cavitation. It is shown that a compound of sodium luminol and sonically produced peroxide may be energised to produce chemiluminescence in the absence of the usual secondary oxidants, the reaction giving visual confirmation that chemical activation occurs during sonic cavitation. The results represent an elaboration of earlier work in the audible range and an extension to the audible of effects previously observed in the ultrasonic range. Some effects new at either range are reported and certain theoretical conclusions are drawn which probably are general for all frequencies.

AUTHORS.

4300. Sound Absorption of Porous Materials. M. Rettinger. *Acoustical Soc. of America, J.* 8. *pp.* 53–59, *July*, 1936.—The paper is entirely theoretical. Four physical constants of an acoustic material are defined: the thickness L, the porosity P, the amount of vibrating mass *m* per unit volume, and the flow resistance R. By means of an electrical analogy an expression is obtained for the absorption coefficient at normal incidence of a thick non-flexible material in terms of the porosity and flow resistance. The absorption coefficient of small thicknesses of material of low flow resistance is quoted from calculations in an earlier paper [see Abstract 821 (1935)]. Comparison of calculated values with those observed for an acoustic tile shows differences which are attributed to the assumption that $m =$ density of air. Recalculations of the absorption with a corrected value for *m* based on an assumption of Wintergerst leads to more satisfactory values within certain limiting conditions. K. M. C.

4301. Sound-Insulating Value of a Double Partition. J. E. R. Constable. *Phys. Soc., Proc.* 48. *pp.* 690–698, *Sept.* 1, 1936.—A study is made of the effect of rendering the interior of double partitions acoustically absorbent. A formula is derived for the effect of the treatment and is confirmed by measurements made upon double partitions containing various amounts of absorbent. The measurements show that considerable increases in the sound-insulation of a double partition can be obtained by the judicious use of it. In particular, in the case of a double window, an increase of some 8 db can be obtained by covering with absorbent the wall surfaces enclosed between the two panes of glass. AUTHOR.

4302. Philips-Miller System of Sound Recording. R. Vermeulen. *Philips Techn. Rev.* 1. *pp.* 107–114, *April*, 1936.—On the ordinary disc sound is recorded and reproduced mechanically; in the photographic method of sound recording, both recording and reproduction are carried out by optical means. Mechanical reproduction on the one hand and optical recording on the other possess certain inherent disadvantages. The Philips-Miller system of sound-recording, whose principles are discussed in this article, avoids these disadvantages in that the sound-track is recorded on the film by mechanical means and is then reproduced optically. AUTHOR.

4303. Audibility of Short Period Notes. H. D. Bouman. *Zeits. f. Biologie*, 97. *pp.* 44–54, 1936.—Extending the earlier work of Bouman and Kucharski (*L'Année Psychologique*, 29, *p.* 166, 1928) the author has examined the phenomena which occur when the frequency of a note is changed for a short period and is then returned to its original value. It appears that unless the change is maintained for at least eight periods of the note a definite note is not observed but it sounds more as a "click." For the effect to be observed the change of frequency must be more than 40 ∼. The clicks have some musical character as clicks due to different frequency changes can be distinguished provided the difference between the two changes is greater than 40 ∼. The results are independent of the sound intensity and the frequency of the base tone. The effect of sounding two clicks directly after one another is to increase the possibility of hearing them as a pure note. There is in fact a summation effect provided the clicks occur within 0·1 sec. of each other. A succession of clicks of different frequency sound similar to a continuous spectrum noise and it is possible to obtain effects similar to warble tones. It is concluded that notes and noise are heard by the same mechanism in the ear. J. E. R. C.

4304. Threshold of Audibility and Impedance of the Ear Drum. L. Keibs. *Ann.d.Physik*, 26. 7. *pp.* 585–608, *Aug.*, 1936.—Following previous work [see Abstract 3284 (1936)] a method of determining the effective sound pressure at the ear drum is described, enabling this quantity to be measured at the threshold of audibility. It is calculated that if one end of a tube of length l is inserted in the ear, the effective sound pressure at the other end being p_a, then the effective sound pressure p_f at the ear drum is given by $p_f^2 = p_a^2 . e^{-2bl}$, where b is the absorption per unit length of tube. The quantity p_a is given for a telephone and for a thermophone, and the sound pressure in various observers' ears at the threshold of audibility is obtained for a number of frequencies between 200 and 3600 ∼. The impedance of the ear drum is obtained by measuring the sound pressure at an intermediate point in the tube (*a*) when the end is rigidly closed and (*b*) when it is closed by the ear drum. K. M. C.

4305. Subjective Phenomena Accompanying a Frequency Vibrato. W. E. Kock. *Acoustical Soc. of America, J.* 8. *pp.* 23–25, *July*, 1936.—To the human ear there is a marked resemblance between a narrow frequency vibrato and a narrow amplitude vibrato for pure tones and the suggestion has been made that the frequency vibrato subjectively associated with every intensity vibrato introduced a psychological effect which prevented the ear from distinguishing between a true narrow frequency vibrato and that subjectively engendered by a plain amplitude vibrato. Tests carried out with pure tones supplied by a suitable valve generator showed definitely that the phase of the subjective intensity vibrato associated with a pure frequency vibrato was also subjective in that it could be shifted at will by the listener. Concentration on any particular frequency of the tone interval traversed during a vibrato cycle caused the subjective intensity to seem greatest at that particular point of the cycle. It appears therefore that the subjective intensity vibrato accompanying a frequency vibrato is due to the rhythmic sense of the listener imparting an accent to a particular point in the vibrato cycle, and that the point to which this accent is given is arbitrary. A. W.

***4306. Sound-Level Meter. A. J. Muchow.** *Gen. El. Rev.* 39. *pp.* 293–296, *June*, 1936.—A new sound-level meter designed to conform to the recommendations of the Acoustical Society of America is described. The instrument is compact, weighing, complete with batteries, 30 lb. The microphone is of the piezoelectric type. The range of the instrument is 30 to 120 db and it contains a frequency weighting network which can be switched in at will. It is calibrated by a small mouth-blown pipe which generates a 1000-cycle note of definite intensity. The accessories are a portable heterodyne type analyser and a pick-up for structure-borne vibration. J. E. R. C.

4307. Psychophysiological Acoustics. Pitch and Loudness. S. S. Stevens and H. Davis. *Acoustical Soc. of America, J.* 8. *pp.* 1–13, *July*, 1936.—The problem of psychophysiological acoustics is to determine the characteristics of auditory sensation in terms of the physical dimensions of the stimulus and the relation of physiological phenomena (in animals) to the same stimuli, and by comparison to infer the relation of the psychological function to the physiological. Four such correlations have been examined: (1) Data previously reported show a fairly good correspondence of the threshold function of electric response and the psychological thresholds. (2) Pitch perception depends upon selective resonance of different portions of the basilar membrane, although an intense tone activates a large area. The positions of maximal sensitivity were determined by the effect of localised lesions of the cochlea upon the threshold for electrical response. The resulting map was compared with the map derived from the integration of Shower and Biddulph's data on pitch discrimination. The correspondence is very close. (3) The equal loudness contours of Fletcher and Munson were compared with the corresponding contours of intensity required to produce equal electric responses from the cochlea. The correspondence is satisfactory. (4) The loudness function of Churcher was compared with the relation between the intensity of a 1000-cycle tone and the magnitude of the electric response of the cochlea. The functions are similar as a first approximation, except at high intensities. Theoretical explanations of the deviations are suggested. J. E. B.

4308. Change of Pitch with Loudness at Low Frequencies. W. B. Snow. *Acoustical Soc. of America, J.* 8. *pp.* 14–19, *July*, 1936.—The change of pitch resulting from change of intensity of l.f. tones is measured. Frequencies ranging from 75 to 1000 ~ were used and loudness levels ranging from 20 to 120 db. All consistent judgments gave downward pitch changes with increasing loudness, though not all observers agreed upon this. A set of contours of equal loudness level, plotted on coordinates of frequency and pitch change per cent is given. The greatest shift occurs at the lower frequencies. J. E. R. C.

4309. Influence of Intensity upon Pitch of Violin and 'Cello Tones. D. Lewis and M. Cowan. *Acoustical Soc. of America, J.* 8. *pp.* 20–22, *July*, 1936.—Earlier work has indicated a change of pitch with intensity. To test this the authors have taken oscillographic records of notes emitted by violins and 'cellos when played loudly and softly. Arguing that whatever the intensity the players will play a musically correct interval a change of absolute frequency has been looked for. The evidence is inconclusive. J. E. R. C.

See also Abstracts 3955, 3973, 4151.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

4310. Vector Diagram of Schering Bridge. F. Alten. *E.T.Z.* 57. *pp.* 807–808, *July* 9, 1936.—Development of the vector diagram of the Schering bridge which shows in a convenient way the relative changes of the various quantities involved as the settings of the bridge are changed. L. H.

***4311. Rectifier Bridge for A.C. K. Karandejew.** *Techn. Phys., U.S.S.R.* 3. 4. *pp.* 356–360, 1936. *In German.*—An arrangement of copper-oxide rectifiers is combined with a d.c. galvanometer as a detector in a simple bridge for the comparison of capacitances and of self-inductances at power frequencies. T. I. J.

4312. Valve Circuit for Determining Directly the Differential of a Function Represented by an Electric Current. J. Stohr. *Comptes Rendus*, 203. *pp.* 60–62, *July* 6, 1936.—A circuit is described, making use of two valves connected in parallel, with self-inductances and resistances in the anode leads, which are chosen so that the p.d. between two points in the circuit connecting the two anodes is proportional to the differential of the anode current of one valve. Tests of the arrangement verified the theoretical results. A. W.

CONDUCTION AND DISCHARGE IN GASES.

4313. Hysteresis with Sliding Electric Discharges. R. Schiering. *Arch. f. Elektrot.* 33. *pp.* 455–460, *July* 22, 1936.—Sliding electric discharges, which are h.v. gas discharges along the surface of a dielectric, include various discharge types, such as brush discharges at the poles, sliding brushes and sparks. All these types exhibit after effects due to heating, conductivity and molecule formation. An investigation was made of the after effect of a surge voltage discharge on the spreading of the slip figure of a succeeding discharge due to an equal surge voltage. The spreading of the second discharge was found to be reduced by an amount depending on the time difference between the two discharges according to an exponential law. Experiments were made with various types of discharges and with voltages up to about 40 kV. With the smallest time difference the reduction was about 1/3 both for positive and negative discharges. A. W.

4314. Mechanism of Static Spark Discharge. L. B. Loeb. *Rev. Modern Physics*, 8. *pp.* 267–293, *July*, 1936.—A comprehensive review of the phenomena of spark discharges and of the mechanisms which have been proposed to account for the observed effects. The effect of the numerous variables on the sparking voltage in normal static breakdown is discussed at length and the conditions for the occurrence of the different secondary sparking mechanisms are fully dealt with. It is concluded that there is no single definite secondary process which occurs universally in all discharge phenomena, but that there are at least five or, including very low pressures, six mechanisms which may account for the self-maintaining character of spark discharges. Any one or two of these mechanisms in combination may predominate, according to the experimental conditions, to the exclusion of the others. In many cases the conditions indicate at once the favoured mechanism or mechanisms. A. W.

4315. Transition from Glow Discharge to Arc Discharge. T. Jurriaanse and M. J. Druyvesteyn. *Physica,* 3. *pp.* 825–840, *Aug.,* 1936. *In English.*—The probability is studied of the transition of a glow discharge to an arc discharge when the kathode is touched by a conductor. It is found that the probability of this transition (called arcing) depends on a number of variables, *e.g.,* on the capacity and the p. d. between the conductor and the kathode, the current density and the kathode fall of the glow discharge. Arcing may occur in the case of contact making as well as of contact breaking between the conductor and the kathode. The energy of the discharge between the conductor and the kathode is of primary importance to the probability of arcing. AUTHORS.

4316. Intensity Distribution and Total Radiation of the Super-High-Pressure Mercury Discharge. W. Elenbaas. *Physica,* 3. *pp.* 859–871, *Aug.,* 1936. *In German.*—The intensity distribution of some types of super-high-pressure mercury discharges is measured between 0·4 and 3 μ. At higher pressures the spectral lines are broadened more and more and the continuous spectrum is more pronounced. Furthermore the continuous spectrum is enhanced at higher current densities. The total radiation is measured and a correction applied for the absorption of Hg-radiation by the cooling water. As an example, in the case of a discharge in a tube with 1 mm. inner dia. at 1·1 A and 800 V/cm., the total radiation amounts to 75 % of the energy supplied. Some reasons are discussed, which may explain the fact that the ratio of the intensity of the yellow lines (5770—5790 Å) to that of the green line (5461 Å) is smaller than in the tubes of the one atmosphere type. AUTHOR.

4317. General Theory of Probe Currents in Gas Discharges. G. Spiwak and E. Reichrudel. *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 655–682, 1936. *In German.*—A theory is developed for the current at a cylindrical probe situated in the plasma of a low pressure gas discharge. The assumption is made that the charged particles in the neighbourhood of the probe are subjected not only to an electric field but also to a weak axial magnetic field. Calculation shows that this weak magnetic field has an appreciable effect on the electron current, though little on the ion current in Hg vapour. When the probe is positive relative to the plasma or at the same potential, the effect of the magnetic field is greatest. With the probe negative the magnetic field effect is less and for a particular probe potential the magnetic field has no appreciable effect. The observation of this null effect furnishes a new method for determining the plasma potential at a given point. By coordination of theory with experimental results it is found possible to separate probe currents into their electron and ion components. A. W.

4318. Discharge in Tellurium Vapour. R. Rompe. *Zeits. f. Physik,* 101. 3–4. *pp.* 214–233, 1936.—The discharge between two fluid Te electrodes, with Ne or He filling the discharge tube at a pressure of 10 to 50 mm. was found to resemble closely the discharge between liquid Hg electrodes at atmospheric pressure. The Te discharge at 1 mm. pressure shows about the same contraction of the positive column as is found in the Hg discharge at about 100 mm. Measurements were made of the potential required for maintaining the discharge between Te electrodes for different pressures and current strengths. Separation of the potential into that of the positive column and that at the electrodes gave a gradient appreciably higher than for other metal-vapour discharges. The electrode fall varied only slightly with pressure and current strength. An estimate is made of the power consumed by recombination of Te atoms. The observed continuum of the Te discharge is shown to be attributable to the recombination light of Te atoms. A. W.

4319. Rare-Gas Mercury Lamps. K. Siebertz. *Zeits. f. Physik*, 101. 3–4. *pp.* 255–259, 1936.—The striking difference in behaviour of a mercury lamp containing pure Ne and one containing in addition 10 % A (pure neon gives an abrupt colour change of the emitted light as the Hg pressure is varied whereas the mixture Ne + 10 % A or pure A fails to show such an effect) is here shown to correlate with the variations of voltage across the lamp as the Hg pressure is varied. To obtain an explanation of the effects observed, measurements of the velocity distribution of the electrons in the positive column of the discharge were made, using Langmuir's probe electrode method. A preliminary account of the results obtained is presented and shown to provide a complete explanation of the original phenomena. W. S. S.

4320. Force at an Anchored Kathode Spot. L. Tonks. *Phys. Rev.* 50. *pp.* 226–233, *Aug.* 1, 1936.—The steadying effect of a metallic anchor for the kathode spot of a mercury-pool arc is used to make measurements on the force at the kathode. Two methods are used. One is based on the depression of the meniscus edge carrying the kathode line, due to the pressure on it. This measures only the horizontal component exerted on the liquid and gives 19 dynes/A. The other uses a torsion pendulum to measure the total horizontal force component and gives 33 to 43·5 dynes/A over the current range zero to 10 A. This is supplemented by a determination of the direction of the force based on the deflection of the kathode line by a magnetic field, giving 35 to 66 dynes/A for the resultant in the same current range. The results show interaction of current streams from different emitting areas to increase the force, and are not inconsistent with other determinations. [See also Abstract 4648 (1935).] AUTHOR.

4321. Recombination in Negative Glow. Investigations in H. H. Fischer. *Ann. d. Physik*, 27. 1. *pp.* 81–91, *Sept.*, 1936.—A large probe of widely spaced brass wire was used to investigate the negative glow of a discharge in H at a pressure of about 1 tor. With a probe potential of about − 10 V relative to the surrounding gas, currents flow to the probe which are appreciably greater than the measured discharge current at the kathode. These probe currents are discussed and the experimental evidence favours the conclusion that they are ion currents. It appears that under the conditions obtaining in the discharges in question we are concerned with ions which, in discharges without the probe, are annihilated by recombination in the discharge tube. The magnitude of the probe currents shows that such recombination is large in the negative glow of H discharges. A. W.

4322. Total Ionisation of Nitrogen by Electron Collisions. Gladys A. Anslow and Madeleine de B. Watson. *Phys. Rev.* 50. *pp.* 162–169, *July* 15, 1936.—The total ionisation produced in N_2 by beams of electrons of homogeneous velocity and energies up to 1500 V increases rapidly up to 75 V, then less rapidly but linearly to 375 V, for which there is

V
1

a break in the ionisation curve, indicating the onset of K electron ionisation; the ionisation again increases rapidly near 750 V and after 1200 V increases less rapidly but linearly with increased electron energies. The mean effective ranges and electron energies nearly obey the equation $R_e = 0 \cdot 07 + 1 \cdot 88 \times 10^{-6} V^2$ cm. at 1 mm. pressure. The average total ionisation per cm. of absorbing gas layer is calculated by dividing the total ionisation produced by electrons by their effective ranges, and shows a maximum above 100 V in the region of primary ionisation, and a second maximum at 750 V, twice the ionisation potential of the K electrons of N, these characteristics being similar to those for the total ionisation in air. N. M. B.

4323. Ionisation, Excitation, and Chemical Reaction in Uniform Electric Fields. Part I. Townsend Coefficient of Ionisation. K. G. Emeléus, R. W. Lunt, and C. A. Meek. *Roy. Soc., Proc.* 156 *A*. *pp*. 394–411, *Aug*. 17, 1936.—This paper makes an attempt to calculate the absolute values of Townsend's coefficient of ionisation, αp^{-1}, in various gases. The only data employed are the experimental results on the absolute efficiencies of ionisation by electrons of known energy as determined by Tate and Smith, the ratio of the mean energy of the electron swarm to the thermal energy of the gas, and the drift velocity of the swarm as determined by Townsend. The only assumption made is that of the form of the distribution function for the velocities in the electron swarm. Except for low values of $\mathrm{X}p^{-1}$, good agreement with the experimental results over a wide range of $\mathrm{X}p^{-1}$ is found for diatomic gases, particularly for H_2, by assuming a Maxwellian distribution and without the use of any adjustable constants. A brief discussion of other cases in which agreement is not obtained is also included. AUTHORS.

***4324. Second-Order Focusing for the Mass-Spectrograph. W. W. Sawyer.** *Cambridge Phil. Soc., Proc.* 32. *pp*. 453–460, *July*, 1936.—Second order focusing can be obtained with an apparatus, which contains a circular magnetic field and differs little in its dimensions from the apparatus at present in use. The layout is shown to scale in a diagram, essential data are collected, and indications of the accuracy to be expected are given. AUTHOR.

4325. Positive-Ray Analysis of Ions from a H.F. Spark. Sheng-Lin Ch'u. *Phys. Rev.* 50. *pp*. 212–215, *Aug*. 1, 1936.—This paper gives the analysis by the Thomson parabola method of the positive rays of various materials produced by the h.f. spark method developed by Dempster [see Abstract 811 (1936)]. The spark materials investigated may be classified into three groups, *i.e.*, metals of high melting point, metals of low melting point and minerals. It was found that almost all the ions obtained were atomic and that most of the elements gave multiply charged ions. The change of charges during the passage from the accelerating field to the analysing field was also observed. Ions of the elements which exist ordinarily in the gaeous state were obtained from the solid compounds of which these elements form constituents. He ions were obtained from the radioactive mineral, cleveite ($UO_2 \cdot UO_3 \cdot PO \cdot ThO_2$). From the experiments thus far performed, the h.f. spark method has been shown to be able to give strong sources of multiply charged ions of almost all the elements. AUTHOR.

4326. Energy Distribution of Backward-Diffused Kathode Rays. J. O. Brand. *Ann. d. Physik*, 26. 7. *pp*. 609–624, *Aug*., 1936.—The velocity distribution of backward-diffused kathode rays for primary velocities of 16, 24 and 32 kV was investigated for the metals Al, Cu, Ag and Pt with different deflection angles ranging from 94° to 164°. The metal thickness was greater than the backward-diffusion thickness. The velocity spectrum was produced by magnetic deflection and recorded photographically. A broad velocity spectrum was observed with a maximum corresponding to an energy loss of from 10 to 20 %. For light elements it was found that with increased deflection angle the spectrum was broader and the maximum moved towards greater energy loss. For the heavier elements this dependence on deflection angle is less marked and for Pt is too small to be observed. The results are discussed in their bearing on the interconnection between diffusion and energy loss. A. W.

See also Abstracts **3917, 3918, 4119, 4124, 4138, 4163, 4164, 4179, 4180, 4192, 4219, 4225, 4226, 4227, 4396, 4406.**

CONDUCTION IN SOLIDS AND LIQUIDS.

4327. Resistance and Thermoelectric Properties of the Transition Metals. N. F. Mott. *Roy. Soc., Proc.* 156*A. pp.* 368–382, *Aug.* 17, 1936.—Explanations are given in terms of the quantum theory of metals of the following phenomena: The decrease in the temperature coefficient of resistance of Pd and Pt at high temperatures; the large negative thermoelectric power of Pd and Pt; the increase in the absolute magnitude of the thermoelectric power of Pd when it is alloyed with Cu, Ag, Au or H, and the sudden drop for higher concentrations; the sudden change in the temperature coefficient of resistance of ferromagnetic metals at the Curie temperature; the behaviour of the thermoelectric power of Ni near the Curie temperature. [See also Abstracts 3139 (1935) and 813 (1936).] AUTHOR.

∗4328. Resistors and Atmospheric Humidity. P. H. Dike. *Rev. Sci. Instruments*, 7. *pp.* 278–287, *July*, 1936.—Resistors made with enamel-coated wire show a greater secular stability under the influence of varying humidity and temperature than those coated with shellac or wax. Coverings of cotton, silk, or linen cause fluctuations of resistance with relative humidity, the effect being due to changes in the mechanical force exerted on the wire by the fibres wrapping it. The effects of silk and cotton are of opposite sign, and a suitable mixture of the two gives a covering which causes no change of resistance with humidity. Resistors of enamelled wire so covered are as constant as those sealed in oil. Formers of bakelite, wood, or silk-covered metal also give rise to changes of resistance with humidity, and enamelled-metal or ceramic formers should be used. A substantial coating of ceresin affords the resistor mechanical protection and greatly reduces leakage at high humidities. L. H.

4329. Electrical Resistance of Liquid Helium. M. Wolfke and W. H. Keesom. *K. Onnes Lab. Leiden, Comm. No.* 242*f. Physica*, 3. *pp.* 823–824, *Aug.*, 1936. *In English.*—The specific resistance of liquid He is found from 1·28° K. to 4·22° K. to be at least $10^{15}\,\Omega$ cm. AUTHORS.

4330. Carrier Electrons of Supraconductivity. R. Forrer. *Comptes Rendus*, 202. *pp.* 2059–2061, *June* 22, 1936.—Those metals are supraconducting which have only *s* electrons between the completed levels and the " electronic lattice " [see Abstract 4624 (1935)]. It is these *s* electrons which are the carriers of supraconductivity. C. A. S.

4331. Temperature Coefficient of Electrical Resistance and Resistivity at 20° C. for Aluminium of Varying Purity. M. Henri. *Rev. de Mét.* 33. *pp.* 420–421, *July*, 1936.—The coefficient of electrical resistance, as defined by $\beta = (R_2 - R_1)/R_1(\theta_2 - \theta_1)$, $= (\alpha - \gamma)$, where $\alpha = (\rho_2 - \rho_1)/\rho_1(\theta_2 - \theta_1)$, *i.e.*, the temperature coefficient of resistivity, and γ is the coefficient of thermal expansion. R is measured over a fixed length for the Al specimens of varying purity in a petroleum bath by means of a Kelvin bridge. A cast billet of metal, 4 cm. in dia., is rolled at 400° C. to 1·2 cm., cold-drawn to 0·8 cm. and annealed at 320° C. for 3hrs. followed by slow cooling in the furnace. Values obtained are :

% Al	Impurities %				$\varrho_{20°}$ C. in Ω^{-6} cm.$^{-1}$	β	Range (°C.)	$\beta \times \varrho_{20°C.}$
	Fe	Si	Cu	Mg				
99·996	0·0005	0·0023	0·0009	—	2·620	0·00433	20·2°–77·3°	0·01134
99·56	0·34	0·10	—	—	2·767	0·00400	21·1°–68·5°	0·01107
99·12	0·56	0·32	—	—	2·780	0·00413	21° –72·9°	0·01152
98·63	0·96	0·41	—	—	2·835	0·00400	20·8°–75·8°	0·01134
98·36	0·34	0·52	—	0·78	2·995	0·00342	19·8°–67·1°	0·01024

The possible error in the final column is ± 2·4 % and Mathiessen's law $\rho_t \beta_t =$ const. is therefore satisfied between 100 and 98·63 % Al. D. R. H.

4332. Influence of Atmospheric Gases on Electrical Conductivity of Cu$_2$O. L. Dubar. *Comptes Rendus*, 203. *pp*. 46–48, *July* 6, 1936.—It is reported that an outgassed plate of Cu_2O when exposed to H_2O vapour or N_2 does not show any appreciable change in its low conductivity, but exposure to O_2 causes a large increase. If the vessel containing the specimen after exposure to O_2 is evacuated, and then filled with N_2 there is a slight decrease in the conductivity ; if H_2O vapour is introduced instead, however, there is a rapid decrease in the conductivity, provided that the exposure to O_2 was fairly short. D. H. F.

4333. Electronic Semiconductors. G. Liandrat. *J. de Physique et le Radium*, 7. *pp*. 297–304, *July*, 1936.—A critical report on a large number of papers dealing with the distinction between electronic and ionic conduction in semiconductors, the investigation of their volume properties and the interpretation of the phenomena. R. P.

4334. Conductivity of Alkali-Water-Acetone Solutions. W. H. Hatcher and C. T. Mason. *Canad. J. of Research*, 14. *Sect. B. pp*. 195–203, *June*, 1936.—Increased acetone concentration in aqueous solutions of NaOH lowers the specific conductivity to a marked degree. This cannot be satisfactorily explained by viscosity change only, but is probably accounted for by a combination of changes in both viscosity and dielectric properties of the solutions. An empirical equation is suggested. AUTHORS.

4335. P.D. in Metallic Electrodes of Electrolytic Cells. C. Snow. *Bureau of Standards, J. of Research*, 17. *pp*. 101–124, *July*, 1936. —In certain precise measurements of electrolytic resistance of solutions, the platinum electrodes are necessarily very thin so that one cannot neglect the drop of potential in them. Formulæ are obtained for this drop in the case of two types of cylindrical cells, one in which the current is axial, the other partly axial and partly radial. The potential admits of accurate evaluation in the first case and the results obtained confirm the method outlined for the treatment of a general shape of cell. AUTHOR.

See also Abstracts 3948, 4007, 4090, 4096, 4247, 4254, 4273, 4345, 4346, 4368, 4369, 4374, 4397, 4408, 4421.

DIELECTRICS AND CAPACITANCE.

4336. Dielectric Constants of Gases and Vapours. M. Kubo. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 637. *pp.* 179–187, *July*, 1936. *In English.*—The dielectric constants of the vapours of methylene glycol dimethyl ether (methylal), the molecule of which has two axes of free rotation, are measured for various temperatures. They are used to calculate the dipole moment which increases with rising temperature. Theoretical discussions are given from the standpoint of intramolecular rotation and the following conclusions are derived. Even at temperatures as high as 200° C. the rotations are not perfectly free, but are hindered to some extent. The molecule executes rotational oscillations around the two axes of free rotation. The most stable configuration is that in which two CH_3 groups are located at the opposite sides of the plain containing the central C atom and the two O atoms. It is also shown from the considerations of intramolecular forces that plain forms cannot be the most stable configuration. [See also Abstract 5184 (1935).] AUTHOR.

4337. Dielectric Constants of Dioxane-Water Mixtures between 0 and 80°. G. Åkerlöf and O. A. Short. *Am. Chem. Soc., J.* 58. *pp.* 1241–1243, *July*, 1936.—The dielectric constants of a series of dioxane-water mixtures are measured over the temperature range 0 to 80° for a wave-length of 150 m. using a resonance method. AUTHORS.

4338. Dielectric Constant of HCl and H_2SO_4. E. Fischer. *Ann. d. Physik*, 26. 8. *pp.* 697–704, *Aug.*, 1936.—A further contribution to the discussion in progress between various German investigators [see Abstracts 1322, 1323 and 1818 (1936)] concerning a saturation effect in the increase of dielectric constant at radio frequencies with increasing concentration of strong acids. The present author reports that at 300 m. bridge measurements showed an increase of dielectric constant with no apparent saturation as the concentration was increased 0·001 normal. W. H. W.

4339. Dielectric After-Effect in Solidified Dielectrics. P. A. Thiessen, A. Winkel and K. Herrmann. *Phys. Zeits.* 37. *pp.* 511–520, *July* 15, 1936.—Resin-wax mixtures acquire permanent charges if h.v. stresses are applied during the process of cooling from the molten state. The influence of field strength and electrode materials on these permanent charges is investigated. There are two kinds of charges: (*a*) with voltage stresses less than 10 kV/cm. a charge is produced which is due to movements of the ions in the material to the electrodes; (*b*) with stresses greater than 10 kV/cm. charges of opposite sign are produced due to movements of charge-carriers from the electrodes. Depending on the value of the stress applied during cooling, the permanent charges may therefore be of either sign. E. R.

4340. Breakdown Field-Strength of Solid Dielectrics between 1 and 15 Mc. R. Becker. *Arch. f. Elektrot.* 30. *pp.* 411–429, *July* 22, 1936.—To avoid edge effects and surface breakdown special designs of specimens and electrodes were employed in these measurements. In the cases of glass and mica the specimens were immersed in special liquids. Generally, breakdown field-strength was observed to decrease with increase of frequency. Of the materials tested mica and glass showed the greatest decrease in the frequency range 1·5 to 13 Mc. Measurements of d.c. conductivity and loss angle at various temperatures and frequencies enabled the observations to be compared with the Wagner theory of thermal breakdown. Particularly good agreement was obtained in the case of glass. A new theory of thermal breakdown is built up from a consideration of the temperature distribution throughout the specimen for particular voltages. Experimental observations compare favourably with this theory. A. J. S.

4341. Dielectric Constant Anomaly of Organic Acids at Solidification Point. B. Piekara. *Acta Physica Polonica*, 4. 3. *pp*. 303–309, 1935. *In French.*—The author reports the discovery of an anomalously high dielectric constant at the point of solidification of oleic, stearic and palmitic acids. The dielectric constant is found to increase rapidly at the instant of freezing and then fall to a value corresponding to that of the solid acid. The anomaly is not found to occur with acetic, caprylic or monochloracetic acids. The experiments were carried out with wavelengths of between 200 and 3000 m. Errera found a similar effect (but more pronounced) in acetic acid, which, however, did not occur for audio frequencies (680 ∼). The effect was explained by colloidal association taking place at the freezing point. The author suggests that to explain the effect for the higher frequencies the colloidal phase must be composed of much smaller particles (such as in a gel). To verify this hypothesis the dielectric constant of a mixture of palmitic acid and hexane of various concentrations was studied. A. M. T.

4342. Structural Dielectric Losses in the Crystalline and Solid Amorphous States. B. Alexandrov, P. Kobeko and E. Kuvshinski. *Techn. Phys., U.S.S.R.* 3. 6. *pp*. 495–507, 1936. *In English.*—A study has been made of the temperature-frequency relations of the dielectric losses and dielectric constants in sugar and glucose. Losses of a relaxation character have been found in the case of the solid amorphous state. The concept " Structural losses " is discussed. AUTHORS.

4343. Absorption of H.F. Waves by Various Alcohols. R. Zouckermann and R. Freymann. *Comptes Rendus*, 202. *pp*. 2079–2081, *June* 22, 1936.—The absorption of h.f. waves (3 to 12 m.) in various alcohols was studied, in order to find the variation in a homologous series. In no case were bands observed in the regions indicated by Haase and Krause. It was also found that for a given wave-length σ increases rapidly and then tends to a constant value with respect to a given homologous series for members possessing more than five carbon atoms. This is not directly indicated by Debye's theory nor by the results of Malsch. [See also Abstract 2720 (1935).] A. M. T.

4344. Dielectric Losses at High Frequencies. J. Henrion. *Comptes Rendus*, 203. *pp*. 52–54, *July* 6, 1936.—The dimensions of polar molecules are derived from the relaxation times of the molecules, which are determined from measurements of dielectric losses at a wave-length of 7 m. The experimental values of the molecular radii of a number of liquids are found to be in good agreement with the calculated values. Also for dilute solutions of polar liquids in non-polar solvents, the time of relaxation τ is found to be proportional to η/T in accordance with the Debye equation : $\tau = 4\pi\eta a^3/\kappa T$, where η is the viscosity, a the molecular radius, κ Boltzmann's constant and T the absolute temperature. E. R.

4345. Electrical Investigation of the Polymerising Oxidation Processes in Liquid Dielectrics. A. Lasarev and J. Raschektaev. *Techn. Phys., U.S.S.R.* 3.4. *pp*. 366–388, 1936. *In English.*—A comparative study of the changes of the electrical characteristics (dielectric loss, conductivity) and of the physico-chemical characteristics (viscosity, density) arising from the heat treatment of drying oils is made. The chief conclusions deduced from the results are as follows. The electrical conductivity of polymerised oils depends only on the mobility of the ions and changes in the macroscopic viscosity. The effect of increased temperature is to increase the decomposition of secondary associated complexes. The temperature characteristics of the conductivity and viscosity are exponential and indicate a high energy of attachment of the primary complexes in the secondary associated complexes. The Debye dipole theory adequately accounts for the temperature changes of the dielectric losses and constants of all the polymers and oxides examined. It is considered probable that under the conditions associated with large complexes the latter cannot rotate and only individual polar groups contribute to the losses. The results show the possible applicability of the electro-physical method to the study of polymerisation processes. A. M. T.

***4346. Absolute Capacity of Condensers. J. Clay.** *Physica*, 3. *pp.* 757–762, *Aug.*, 1936. *In English.*—Three variable steel condensers were constructed which gave mutually agreeing results so that the capacity may be found from the dimensions which were known with an accuracy of 1 in 20,000. A method is given to determine the value of the capacity of a fixed condenser with an accuracy of 1 in 10,000. The electrometer used is described. AUTHOR.

See also Abstracts **3930, 4096, 4172, 4173, 4234, 4246, 4247, 4260, 4380.**

ELECTROCHEMISTRY.

4347. Electrolysis of Solutions of Titanium Salts. H. Emmanuel-Zavizziano and M. Haïssinsky. *Comptes Rendus*, 203. *pp.* 161–163, *July* 15, 1936.—Experimental conditions are given for obtaining compounds of $\mathrm{Ti}^{\mathrm{ii}}$, $\mathrm{Ti}^{\mathrm{iii}}$ or $\mathrm{Ti}^{\mathrm{iv}}$ or pertitanic acid on the electrolysis of an aqueous solution of the product of fusion of titanium dioxide with sodium bisulphate. L. V. C.

4348. Polarisation Capacity of the Mercury Electrode. T. Borissowa and M. Proskurnin. *Acta Physicochimica*, 4. 6. *pp.* 819–828, 1936. *In German.*—The capacity of the double layer on Hg in solutions of HCl, KCl, and CsCl is measured. A maximum is observed in all cases in the range $-0{\cdot}4$ to $-0{\cdot}5$ V measured against Hg in *N* KCl, Hg_2Cl_2. The curve tends to rise with intensive kathodic polarisation. F. J. B.

4349. Platinum Electrode Potential. A. Slygin, A. Frumkin and W. Medwedowsky. *Acta Physicochinica*, 4. 6. *pp.* 911–928, 1936. *In German.*—The dependence of the potential of the Pt electrode upon the adsorbed acid and alkali is investigated. Solutions of H_2SO_4, HCl, HBr, and mixtures of these acids with their sodium salts, and NaCl, NaOH, NaBr and KOH are employed as electrolytes. It is found that the alkali adsorption in hydrogen, observed in anodic polarisation is not changed in salt solutions, at first, but tends to decrease later. The interval during which the adsorbed amount is independent of the potential is greater in alkaline solutions than in acid. The slow reduction of an oxidised electrode and the change in the adsorbed amount by H_2 is observed in H_2SO_4 and Na_2SO_4. F. J. B.

See also Abstracts **3943, 3945, 3946, 3947, 3977, 3978, 4203, 4289, 4335.**

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

4350. Wave Theory of Positive and Negative Electrons. A. Proca. *J. de Physique et le Radium*, 7. *pp.* 347–353, *Aug.*, 1936.—The author puts forward a relativistic wave theory of particles with spin and magnetic moment without recourse to spinor calculus. The theory has the following characteristics : relativistic invariance ; usual transition to case of electromagnetic field ; only four complex components to the wave ; it is possible to define a current which satisfies a conservation equation and a charge which is either positive or negative but which has only positive energy values ; both magnetic moment and spin may be also defined. F. C. C.

4351. Annihilation of Positrons. G. C. Wick. *Accad. Lincei, Atti,* 23. *pp.* 352–357, *March* 1, 1936.—The author considers the annihilation of positrons, emitted by a radioactive nucleus, during passage through the atom. This may occur with the emission of two γ-ray quanta or of one γ-ray quantum. In the latter case an electron bound to the nucleus is simultaneously destroyed and the process is analogous to the internal conversion of γ-rays. The probabilities of annihilation of a positron in the two ways specified are evaluated in terms of the atomic number of the nucleus and the velocity of emission of the positron. The probabilities are in general negligibly small, but for very slow positrons may become appreciable. It appears from observations of Ellis and Henderson, that in the spectrum of the positron emitted by radioactive phosphorus, "slow" positrons are absent. The present theory although giving an effect qualitatively in the right direction is unable to account for the absence of positrons of as high a velocity as is required to fit in with the observations. W. S. S.

4352. Absorption of Corpuscular Rays. S. Titeica. *Zeits. f. Physik,* 101. 5–6. *pp.* 378–397, 1936.—Bethe and Bloch have shown that the stopping power of a material for corpuscular rays depends on the average excitation energy of its constituent atoms. The present paper derives the average excitation energy on the basis of the Thomas-Fermi atom by the following method. The energy absorbed from the passing corpuscular ray by an electron in the atomic swarm is determined as a function of the elements of the electronic orbit. The energy absorbed by the complete atom is then obtained by integrating over the range of orbit elements concerned, these parameters being so chosen that the distribution function equals $2/h^3$. The calculation is carried out for eight elements and the results agree satisfactorily, both in absolute magnitude and in variation with atomic number with those obtained experimentally by Mano. W. S. S.

4353. Impacts of the Second Kind and Electronic Affinity. L. Goldstein. *Comptes Rendus,* 202. *pp.* 2057–2059, *June* 22, 1936.—A new method is described for the study of the electron affinity of molecules of zero permanent moment. The electron affinity of a pure molecular medium (molecules without moment in the normal state) being only that of its atomic impurities, the molecule investigated is dissociated and mixed with a relatively small amount of the atoms of a rare gas ; these atoms are excited to the metastable state either by electronic impact or by discharge. These states are destroyed by impacts of the second kind with the molecules of the primary gas, giving rise to excitation followed by dissociation of the molecules. The electronegative atoms thus liberated cause, by electron capture forming negative ions, a diminution of intensity of the slow electron beam, the intensity of which is measured. Results for O_2, SF_6 and CF_4 as primary gas, and Kr, Xe and A as added gas agree with those obtained by another method [see Abstract 2376 (1936)]. N. M. B.

4354. Radiationless Transitions Involving Three-Body Collisions. R. A. Smith. *Cambridge Phil. Soc., Proc.* 32. *pp.* 482–485, *July*, 1936.—If an atom forms a negative ion, by capturing an electron, the excess energy may be given out in the form of radiation or may be transferred to another particle in a three-body collision. The latter process is investigated, assuming the third particle to be an electron, and using Born's approximation which should give too high a result. Even with this high value it is found that the probability of this process equals that of the emission of radiation only for an electron density of 10^{18}/c.c. The transfer of energy to a second atom is even less likely. R. P.

4355. Forces Acting on High Energy Protons at Collision. A. Bramley. *Frank. Inst., J.* 222. *pp.* 141–148, *Aug.*, 1936.—The interaction between protons at close collisions has been investigated on the basis of the Born-Infeld theory of electrodynamics [see Abstract 1875 (1934)]. The theory predicts, first, that the interaction should have a definite upper limit which depends on the value of the characteristic constant *b* ; secondly, that the magnetic field set up by the moving charges can produce in this interaction, in addition to the terms required by the classical theory of electrodynamics, terms which cannot be neglected in the treatment of close encounters. These terms become of special significance in that problem whenever the relative velocity of the two protons exceeds 3 % of the value of the velocity of light. The bearing of these conclusions on the experiments on the scattering of protons by protons is discussed. AUTHOR.

4356. Inelastic Scattering of Electrons from Solids. E. Rudberg. *Phys. Rev.* 50. *pp.* 138–150, *July* 15, 1936.—The energy distribution of electrons scattered inelastically from solid targets is studied, for primary energies from 50 to 400 V, using the magnetic deflection method. For certain values of the energy loss the curves exhibit maxima characteristic of the substance and independent of the primary voltage. The metals Cu, Ag and Au have maxima below 10 V, which appear to correspond to regions of high optical absorption for the substance. An estimate of the depth of penetration of the electrons is obtained by measurements on Ca, CaO, Ba and BaO films of known thickness deposited on Ag. The result indicates that inelastic scattering is determined by the first few atomic layers near the surface. Measurements of the energy distribution of scattered electrons should prove a sensitive tool for the study of surfaces. C. J. B. C.

4357. Theory of Inelastic Scattering of Electrons from Solids. E. Rudberg and J. C. Slater. *Phys. Rev.* 50. *pp.* 150–158, *July* 15, 1936.—The properties of the single electron wave functions for a crystal are discussed and an expression derived for the probability of excitation by electron bombardment as a function of the two electron levels involved in the transition. A detailed calculation is made for solid copper, for which the energy levels are known from other work. The calculated distribution curve for inelastically scattered electrons is in fair agreement with experiment in the region of small energy losses, showing the maxima in their proper positions. The departure at high losses is attributed to the fact that the free-electron-like wave functions employed are not a proper approximation to the actual functions in this region. C. J. B. C.

***4358. Electron Diffraction by Gas Molecules. L. O. Brockway.** *Rev. Modern Physics*, 8. *pp.* 231–266, *July*, 1936.—An historical survey of the development of electron diffraction as a method of investigation of molecular and surface structures is followed by a comprehensive theoretical treatment of the elastic and inelastic scattering of electrons by atoms and gas molecules. It is shown that under normal experimental conditions with high-speed (40—50 KV) electrons, the use of the Born approximation is quite justified, whilst it is concluded that the effect of thermal vibrations of the atoms will be small in electron diffraction by gas molecules. The design of suitable apparatus and the experimental technique are given in detail. Instead of the more usual liquid-air-cooled surface, a separate high-speed diffusion pump is used for removing the gas under examination from the apparatus, and it is claimed that this arrangement is more effective in eliminating diffuse scattering due to stray gas molecules. The interpretation of gas diffraction patterns by visual and photometric methods is described, CCl_4 being taken as an example. The radial distribution method [see Abstract **1344** (1936)], which has the advantage that no previous knowledge of the molecular structure is necessary, is also explained. The results obtained with CCl_4 by X-ray and electron diffraction methods are reviewed and the advantages of the electron method are discussed. Sources of error are dealt with, and the most probable value of the C—Cl distance in molecules of gaseous CCl_4 is given as 1·755 ± 0·005 A. In the survey of results the value of electron diffraction for the determination of bond types is demonstrated in the case of the chloroethylenes, and the experimental data so far available for inorganic, aliphatic and aromatic molecules is tabulated. This paper is intended as a guide for future workers in the field, and a complete Bibliography is given. A. G. Q.

***4359. Emission of Secondary Electrons from Metal Surfaces by Electron Impact. P. Colombino.** *N. Cimento,* **13.** *pp.* 205–213, *May,* 1936.—Description of a simple apparatus for measuring secondary electron emission from copper between 50 and 500 V. The apparatus contains wax joints in order to allow of easy changes in the arrangement, and therefore cannot be baked as a whole. It is found, however, that by heating the copper target by means of a hot wire put into a convenient position, the emission reaches a constant and reproducible value. This value remains constant for about 10 min. Later it begins to rise because the target adsorbs again gas that is given off by other metal parts. The target must not be overheated. The resulting coefficient of secondary emission agrees with the results which Farnsworth obtained below 250 V. Above this energy it is approximately constant. Indication was obtained of a flat maximum at 500 V, but the values above 55 were not very reliable. R. P.

4360. Secondary Emission Critical Potentials. R. Warnecke. *J. de Physique et le Radium,* 7. *pp.* 318–320, *July,* 1936.—For W, Ta and Ni it is found that there is a certain correlation between the values of the critical potentials observed for secondary emission and the values of the energy levels for the external orbits. A. H.

4361. Energy Distribution of Secondary Electrons from Columbium. L. J. Haworth. *Phys. Rev.* 50. *pp.* 216–219, *Aug.* 1, 1936.—Energy distribution curves of secondary electrons from an outgassed columbium target are obtained with the same apparatus as in similar studies on Mo [see Abstract **3639** (1935)]. The results from Cb are qualitatively similar to those from Mo. " Discrete loss " and " fixed energy " groups of secondary electrons are observed at energies which are in most cases slightly less than the corresponding ones in the case of Mo. The number of elastically reflected electrons was also studied as a function of primary energy. The curve shows marked similarity to that obtained from

Mo, the peaks again being at somewhat lower energies in the case of Cb. It is shown that the lower values of the energies involved in the various phenomena in the present case are to be expected because of the lower atomic number of Cb and because of its larger lattice constant. AUTHOR.

4362. Dimensional Relation for Motion of Electrons in Alternating Fields. E. Brüche and A. Recknagel. *Zeits. f. techn. Physik*, 17. 7. *pp.* 241–242, 1936.—From the equations of motion of an electron in a static electric field certain " dimension laws " may be derived ; *e.g.*, if all the dimensions of the ray path (electrode lengths and distances) are altered by a constant factor, the electron paths are altered by a similar factor ; also, the paths remain unaltered if all the potentials are altered to the same degree. A similar type of " dimension law " may be derived for the case of an alternating field. This " law " is discussed with reference to the Braun tube. H. J. H. S.

***4363. Electron Optical Systems and their Applications. V. K. Zworykin.** *I.E.E., J.* 79. *pp.* 1–10, *July*, 1936.—A review is given of the early work on the electron optics of image formation, followed by a discussion of the problem of producing an electron image of an extended object by purely electrostatic means. The conditions to be fulfilled for a solution of this problem are briefly discussed, various types of electron optical systems which approximately fulfil the conditions are described and certain applications are suggested. Electron optical principles are then applied to a discussion of secondary-emission multipliers (both electrostatic and magnetic types) ; their design and mode of operation are described. Applications of these multipliers are enumerated, the most important of them being as a photoelectric amplifier. H. J. H. S.

***4364. Primary and Secondary Images in the Electron Microscope. H. Boersch.** *Ann. d. Physik*, 26. 7. *pp.* 631–644, *Aug.*, 1936.—In the electron microscope a primary image (electron diffraction pattern) and a secondary image (image of the object) may be obtained. An electron microscope operating at 30 kV is used to form transmission images of a thin Au foil and an arrangement is provided whereby diffraction images of the foil may be compared with the direct images. The latter arise from elastic scattering of electrons by the foil ; owing to the variation in the velocity of the electrons on emergence, an " out of focus " structure is obtained in the image plane (" Dickenstruktur "). Images of the foil are obtained using different apertures ; with small apertures the contrast is greater owing to the screening off of scattered electrons and also the aberrations of the lens are less pronounced than with a large aperture. As a result of the smaller number of electrons scattered inelastically in the central maximum using a small aperture, the chromatic errors of the lens are less evident. Images obtained with central and oblique " dark field " illumination show less contrast at all apertures than in the corresponding direct images, probably on account of the greater number of inelastically scattered electrons. By cutting down the primary image until a single interference maximum is obtained, the crystals in the foil which reflect are imaged with increased intensity, giving rise to a " crystal plane structure " (" Kristallagerungstruktur ") which is superimposed on the " Dickenstruktur." H. J. H. S.

***4365. Electron-Optical " Immersion " Lens. R. Behne.** *Zeits. f. Physik*, 101. 7–8. *pp.* 521–526, 1936.—The properties of an " immersion " lens in which the electrons leave the object with a velocity which is approximately the same as the final velocity has been described [see Abstract 482

(1935)]. Two further important cases are now discussed, (*a*) when the electrons emerge from the object with approximately zero velocity (*e.g.*, hot kathode) and (*b*) when the grid diaphragm of the " immersion " lens is connected to the object. The electron optical properties of the two systems are compared. It also appears that a lens with a funnel-shaped diaphragm is better optically than one with a flat diaphragm. H. J. H. S.

***4366. Errors of Electron Lenses. O. Scherzer.** *Zeits. f. Physik,* 101. 9–10. *pp.* 593–603, 1936.—A simple equation is given for treating the rays passing close to the optical axis of a general system (electric and magnetic fields). It is shown that the chromatic aberration (dependence of the image on electron velocity) can never vanish. The errors of third order are discussed, and it is shown in particular that the spherical aberration can also never vanish. It is, however, pointed out, that it can be made small by reducing the dimensions of the optical system. R. P.

4367. Space-Charge Equation for Electrons with Initial Velocity. G. Plato, W. Kleen and H. Rothe. *Zeits. f. Physik,* 101. 7–8. *pp.* 509–520, 1936.—Considering the space between parallel plane electrodes, Poisson's equation is integrated for electrons having any and the same initial velocity. The potential characteristic and current distribution are calculated and discussed in relation to the observed physical effects. It is found that with variation of the total current both jumps exist which are found experimentally. A. W.

See also Abstracts 3940, 3965, 4119, 4120, 4139, 4219, 4323, 4408, 4417, 4423.

ELECTROSTATICS.

***4368. New Electrometer. E. Perucca.** *Acad. Sci. Torino, Atti,* 71. 1. *Disp.* 2a. *pp.* 230–235, *Jan.–April,* 1936.—A new electrometer working with an auxiliary voltage, which combines the chief advantages of Hoffmann's duant electrometer and Perucca's fibre type. The auxiliary voltage is applied to two horizontal electrodes of sector form corresponding to Hoffmann's duants. The moving system has the stretched torsion-fibre and fibre " needle " of Perucca's earlier instrument, but the " needle " now carries a very thin flat plate which moves over the fixed electrodes. The " active " capacity of the instrument is correspondingly greater. A sensitivity of 5×10^{-4} V per division is obtained with a period of 2 sec., an auxiliary potential of ± 13 V, and a capacity of moving system of 4 cm. L. H.

***4369. Quadrant Electrometers and Leakage. T. R. K. Naicker.** *Zeits. f. Instrumentenk.* 56. *pp.* 276–288, *July,* 1936.—Discusses the effects of leakage observed when quadrant electrometers are used in tropical climates, and the means of diminishing such leakage, *viz.*, drying agents, etc. L. H.

***4370. Increased Power Output of Electrostatic Machines. P. Jolivet.** *Comptes Rendus,* 202. *pp.* 2051–2052, *June* 22, 1936.—Values are given for the augmentation of power obtainable with an electrostatic motor [see Abstract 2381 (1936)] as the air is compressed and for the electrostatic attraction attainable when the air is replaced by compressed propane and CO_2. T. I. J.

See also Abstract 4346.

MAGNETISM AND ELECTROMAGNETISM.

4371. Mass and Energy. K. Wagner. *Phys. Zeits.* 37. *pp.* 522–523, *July* 15, 1936.—It is pointed out that Clerk Maxwell's ideas contained the germ of the notion of the proportionality of mass and energy.

G. C. McV.

4372. Ising's Model of Ferromagnetism. R. Peierls. *Cambridge Phil. Soc., Proc.* 32. *pp.* 477–481, *July*, 1936.—Solution of the statistical problem of a regular array of elementary magnets each of which is capable of two orientations with respect to an external field of fixed direction, and which have an interaction energy tending to orient neighbouring magnets parallel to each other. An approximate solution is given which shows that if the number of neighbours of each magnet is greater than two, the model shows spontaneous magnetisation at low temperatures. For two dimensions, this fact is also proved rigorously.

R. P.

4373. Magnetic Stability of Ferromagnetic Iron Alloys. Part I. W. S. Messkin and J. M. Margolin. *Zeits. f. Physik*, 101. 7–8. *pp.* 456–477, 1936.—Magnetic stability is defined as independence of the differential permeability at low fields of the previous treatment. This, in general, requires that the remanence be less than 15 % of the saturation. The alloy systems Fe-Si, Fe-Mo, Fe-Cu, Fe-P, Fe-Ni-Al, Fe-Mn-Al and some complex α-alloys of Fe, Mn, Al, Cr, Si, and Cu are studied. In general, the stability increases with increasing concentration of the second component, and with the formation of a solid solution; it is decreased by age-hardening. A number of complex alloys are found which combine high stability with low hysteresis losses, high resistivity and good mechanical properties.

R. P.

4374. Continuous Magnetic Spectrum of Transformer Sheet for Sound Frequencies. W. Arkadiew. *Zeits. f. Physik*, 101. 7–8. *pp.* 527–532, 1936.—The angular loss, Δ, in ferromagnetics for sound frequencies in very weak fields ($H \rightarrow 0$) is given by $\tan \Delta_o = kf + e_n$, where kf is a term giving a measure of the eddy-current loss and e_n is Jordan's constant (this is probably a measure of the magnetic viscosity). Several expressions are deduced, relating e_n with f and μ. It is shown that $\Delta \log \mu / \Delta \log f = 2/\pi \times e_n$. Some experimental results in a paper by Goldschmidt are used to verify this expression for the case of Fe-Ni alloys and transformer sheet steel. μ is found to decrease linearly with f for frequencies of 500 to 5000, the rate of decrease agreeing closely with the calculated value. The rate of decrease is less at frequencies below 500 and greater above 5000; reasons for this variation are suggested.

H. J. H. S.

4375. Magnetic Studies of Mixed Crystals of Divalent Copper and Silver. L. Capatos and N. Perakis. *Comptes Rendus*, 202. *pp.* 1773–1775, *May* 25, 1936.—The salts $(Ag . 4C_5H_5N)S_2O_8$, $(Cu . 4C_5H_5N)S_2O_8$, and $(Ag_xCu_y . 4C_5H_5N)S_2O_8$ are studied. The silver salt has a moment of 9·11 Weiss magnetons, and the copper salt 9·78 magnetons. The introduction of small quantities of Ag to the Cu, or *vice versa*, lowers the constant and the Curie point of the predominant constituent. Additivity of properties in the mixed crystals was not observed.

W. R. A.

4376. Magnetic Properties of Antimony. D. Shoenberg and M. Z. Uddin. *Cambridge Phil. Soc., Proc.* 32. *pp.* 499–502, *July*, 1936.—The magnetic susceptibility of Sb both parallel and perpendicular to the trigonal axis is independent of field down to 4° K. The numerical value of the susceptibility parallel to the trigonal axis decreases with increasing temperature, similarly to that of Bi, but perpendicular to the trigonal axis there is no temperature dependence. The results at higher temperatures are compared with earlier measurements and the comparison suggests that the susceptibility of Sb, like that of Bi, is very sensitive to addition of foreign elements. AUTHORS.

4377. Magne-Crystallic Action. Part IV. Magnetic Behaviour of Paramagnetic Ions in the S-State in Crystals. K. S. Krishnan and S. Banerjee. *Roy. Soc., Phil. Trans.* **235***A*. *pp.* **343–366,** *June* **16, 1936.**—A special experimental technique is developed for measuring the small anisotropies of single crystals of manganous and ferric salts. Part of the anisotropy arises from the diamagnetism of the crystal and a much smaller part from the mutual influence of the magnetic moments and their non-cubic arrangement in the crystal lattice. In addition part arises from the Stark splitting of the ${}^6S$ levels under the influence of the crystalline electric fields. The part played by the Stark splitting in various low-temperature phenomena is discussed, and it is shown how from magnetic measurements alone at room-temperature it is possible to predict the entropy-temperature and specific heat-temperature curves of these crystals in the neighbourhood of 0·1° Abs. W. R. A.

4378. Magnetic Susceptibility of Aqueous Solutions of Nitric Acid. S. P. Ranganadham and M. Qureshi. *Zeits. f. phys. Chem.* **33.** *Abt.B.***4.** *pp.* **290–296, 1936.**—The diamagnetic susceptibilities of aqueous solutions of HNO_3 in various concentrations are measured by a modified Quincke method in which the displacement of the liquid in the magnetic field is found by photography. The susceptibility-concentration graph deviates from linearity, and the best straight line through the observed points cuts the susceptibility axis at a point corresponding to a value $0 \cdot 668 \times 10^{-6}$ for water for which the usually accepted value is $0 \cdot 72 \times 10^{-6}$. The NO_6 ion has a gramme-ion susceptibility of $- 20 \cdot 83 \times 10^{-6}$. There are four sharp minima which occur for concentrations corresponding to the compositions: $HNO_3 + 50H_2O$, $HNO_3 + 6H_2O$, $HNO_3 + 4H_2O$ and $2HNO_3 + 5H_2O$. The results indicate a depolymerisation of the water at higher concentrations. G. E. A.

***4379. Paramagnetism of the Mn^{++} Ion in the S State. S. S. Bhatnagar, M. B. Nevgi and R. L. Sharma.** *Phil. Mag.* 22. *pp.* 409–414, *Aug.*, 1936.—The ions Mn^{++} and Fe^{+++} differ from others of the iron group in that they are in ^{6}S state, and so devoid of any angular momentum. In the case of Mn^{++} the theory indicates that the Weiss constant θ in $X_M = CM/(T - \theta)$, is zero. The susceptibilities of this ion at various temperatures correspond to the simple Curie law of inverse dependence on absolute temperature; a result verified experimentally by Jackson and others. Deviations from the rule, however, *e.g.*, θ values ranging from 24 to 28 for Mn ion in $MnCl_2$ and 22–27 for that in $Mn(NO_3)_2$, has led to the present investigation. The magnetic measurements have now been carried out on the manganese salts of organic acids, which can be obtained in a fine state of purity and are devoid of molecular complexities which exist in many inorganic salts. The apparatus employed was a modified form of Gouy's balance, and, for the higher temperature measurements, an electric oven made of mica pieces and nichrome wire was used. It was found that the magneton numbers obtained in Mn salts and Mn^{++} ion were nearly the same, and that the simple Curie law held good in the case of Mn^{++}. A complete set of references to previous work is included. H. H. Ho.

***4380. Self-Inductance of Variable Air Condensers. W. H. Ward.** *Journ. Sci. Instruments,* 13. *pp.* 251–260, *Aug.,* 1936.—Three methods are described by which the self-inductance of variable air condensers may be measured. In the first, a rectangular coil is connected to the condenser, and the total inductance of the circuit is found when the coil is short-circuited at a number of points along its length. The self-inductance of the condenser is found by extrapolating to zero length of the coil. The necessary correction to allow for the capacitance of the coil is discussed, and a method of finding it is described. The second method consists in short-circuiting the terminals of the condenser under test, and finding the frequency of resonance of the circuit so formed. The inductance of the air condenser can then be calculated from the capacitance and the frequency of resonance. In the third method, the effective capacitance of the condenser under test is compared at two frequencies, one low and the other high, with the effective capacitance of a special air condenser of negligible inductance. From the change of effective capacitance with frequency the self-inductance may be deduced. The results obtained by the three methods are shown to be in good agreement. The effect of various sizes of wire as short-circuiting link in the second method is shown, and some results are given on the variation of self-inductance with setting of variable air condensers. AUTHOR.

***4381. Loop Oscillographs with High Recording Speeds. G. Blasczyk.** *Zeits. f. techn. Physik,* 17. 7. *pp.* 242–243, 1936.—Two special types of loop oscillograph are described for use in ballistic work where the periods are of the order of a few millisec. Rapid changes of longer duration than may be obtained with the usual loop or kathode-ray oscillographs may be recorded. In the first type, a rotating film is used, the speed of which may be regulated up to a maximum of 15 m./sec. (length 5 m., width 9 cm.). In the second type, a drum camera is used, enabling film speeds up to 50 m./sec. (length 1 m., width 20 cm.) to be obtained. Three separate circuits may be automatically switched on and recorded. Both types have devices for reducing the amount of waste film to a minimum. A number of applications are briefly mentioned. H. J. H. S.

See also Abstracts 4011, 4029, 4293, 4355.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4382. Muscles and Nerves: Maintenance of Posture. Development of Power, and Transmission of Messages in the Body. A. V. Hill. *Inst. Mech. Eng., Proc.* 131. *pp.* 353–381, 1935. *Hawksley Lecture. Electrician,* 115. *pp.* 743–745, *Dec.* 13, 1935. *Abstract.*—A general review of the contacts between physiology and engineering. Reference is briefly made to industrial physiology, diving, and work carried on at high temperatures, physiology in respect to food preservation, and in respect to atmospheric effects upon aviators flying at great heights. Methods of physiological research, as carried out in the laboratory, in respect to muscular action and response to electrical currents, production of heat in muscles, recovery from fatigue and the horse power developed by human activity in athletics are generally reviewed. Further details of physiological investigation of nerve tissue are given, with respect to velocity of conduction, heat production in the nerves, time constant of excitation response and threshold value, together with a brief discussion of the nervous phenomena in respect to the brain. B. J. L.

4383. Electrical Studies of Living Tissue. A. G. Conrad, H. W. Haggard and B. R. Teare. *Elect. Engineering*, 55. *pp.* 768–772, *July*, 1936.—Electrical studies of living frog and human tissues emphasise the fact that data obtained from electrophysiological studies of frogs cannot be applied directly to human beings. These studies show that frog tissue is practically equivalent to a pure resistance and that human tissue is equivalent to a resistance with relatively high shunt capacitance. These characteristics are believed to influence the response to minimal shocks. AUTHORS.

4384. Specific Action of Ultra-Short Waves. W. E. Curtis, F. Dickens and S. F. Evans. *Nature*, 138. *pp.* 63–65, *June* 11, 1936.—The absorption of short-wave radiation by tissues results in the liberation of heat and many biological effects are due to this cause. A number of workers, however, claim to have observed specific effects, due to other than heating processes, some even suggesting that the effects are restricted to certain wavelengths. A critical survey is made of a number of these claims, and some of the experiments have been repeated. (1) It is shown that the destructive action of 3·4 metre radiation on the metabolism of malignant tissue found by Reiter, was due to inefficient temperature control, no such action being observed if the tissue is kept below 40° C. (2) The so-called " Schliephake effect " of short waves on the surface tension of serum was tested by means of a torsion balance method in which accurate temperature control was possible. No change in surface tension due to short waves was observed even at the highest radiation intensities. (3) It was impossible to obtain confirmatory evidence of the changes in viscosity and stability of colloids observed by Recknagel and Schliephake. (4) Reference is made to the lethal effects of short-wave radiations on staphylococci and tubercle bacilli exposed at body temperatures, and the reduction in activity of diphtheria antitoxin, reported by Haase, Schliephake and Recknagel. It is pointed out that these effects have been shown to be non-existent by Szymanowski and Hicks. (5) Experiments on the dye pinacyanol placed in the radiation field show that there is no decolorisation, as stated by some workers. (6) An unsuccessful attempt was made to verify the observation of Esau that turpentine oil could be hardened in a short wave field. It is pointed out that although some writers have reported physiological effects on workers with short wave apparatus, no such effects were noted in the present case, although very high powered generators were used. (7) The work of Hausser on the anomalies in dielectric constants at high radio frequencies, though as yet unconfirmed, is considered to be one of the most promising lines of attack. It is concluded that the present situation regarding the biological action of short-wave radiations is at present most unsatisfactory, and that no conclusive proof of any specific action other than heating has yet been put forward. J. E. R.

4385. Biological, Technical and Physical Fundamentals of Short-Wave Therapy. E. Schliephake and P. Wenk. *E.T.Z.* 57. 863–868, *July* 23, 1936.—The history and outline of very short-wave therapy are discussed. Experimental work by Esau and Schliephake in 1926 and independent work by Schereschewsky in U.S.A. showed that small animals could be killed by a short-wave field, but it is uncertain if the effect is due to electrical action or to heat. For therapy, oscillations are generated by a suitable valve and the patient is placed between condenser plates inductively coupled to the h.f. circuit. A generator is described and illustrated comprising two valves and having an output up to 650 W at wavelengths continuously variable between 3 and 8 m., using vacuum electrodes. The technique for therapy is given, and various forms of application, including a ring method for local application, a cage for the whole body and plates for the chest, are described. E. H. W. B.

4386. Fasciagraphy. J. R. Carty. *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 747–749, *June*, 1936.—Surgical details of methods of injection of air into the soft tissues of the human subject, to bring into relief muscular and other tissues, with employment of soft X-rays as first suggested by Gratz [see following Abstract]. B. J. L.

4387. Injection of Fascial Spaces. New Method of Soft Tissue Roentgenography. C. M. Gratz. *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 750–751, *June*, 1936.—Illustrates the surgical applications of radiography of the soft tissues, as distinct from bone tissues. Air is injected between muscles and other structures so as to permit muscles to be visualised by use of very soft X-rays. B. J. L.

***4388. Mekapion for Ultra-Violet Measurements. L. W. Pollak and F. Fuchs.** *Gerlands Beitr. z. Geophys.* 48. 1. *pp.* 59–72, 1936.—A Mekapion type of integrating ionisation meter is connected to a Cd-free photoelectric cell to form an u.v. dosemeter. A detailed description is given of the construction and method of use of the commercial instrument. The variation of sensitivity with wave-length is shown for two different types of cell, one suitable for an u.v. dosemeter and one for sunlight measurements. The constancy of the apparatus was tested by continuous exposure to a discharge lamp for 80 min. The use of the apparatus for meteorological measurements is explained and a number of examples given. J. E. R.

***4389. Improved H.V. X-Ray Tube. B. Cassen and K. E. Corrigan.** *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 818–820, *June*, 1936.—The construction of X-ray tubes for very high voltages has previously been discussed by one of the authors [see Abstracts 2665 and 3053 (1934)] and for medical purposes the requirements are (1) to permit the necessary disposition in respect to the patient, (2) protection against X-rays, (3) electrical clearances, (4) in respect to volume and size of the tube and ease of access, (5) expense and (6) space requirements. The end grounded tube for high voltages has the disadvantage that the exciting plant must be built for the full voltage with consequent expense and large space requirements, which disadvantages are overcome by maintaining the tube target at earth potential. A tube is described and illustrated, originally designed for neutron production but applicable for medical purposes, the requirements of which are discussed in detail. B. J. L.

***4390. Safety Device for X-Ray Apparatus. F. W. Bishop.** *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 834–835, *June*, 1936.—A safety device is described to interrupt the X-ray tube operation in the event of breakdown. The relay is inserted into the mid-point earth of the transformer secondary where normally current does not flow but, in the event of contact on either side of the high-tension system or arcing, the symmetry is disturbed and current flows *via* the mid-point earth which operates the mechanical relay which is illustrated. In use in mechanically rectified apparatus, difficulty occurs owing to h.f. currents flowing in the earth lead, but this is overcome by use of a by-pass circuit. A valve rectifier is employed. B. J. L.

***4391. 700-kV X-Ray Tube. A. Bouwers and J. H. van der Tuuk.** *Brit. J. of Radiology,* 9. *pp.* 431–441, *July,* 1936.—Previously described X-ray tubes for voltages above 400 kV are usually of the continuously evacuated type. A new tube, of the more flexible sealed-off type, which has been run for over 300 hrs. at 600 kV, is described. The kathode and target are built into separate tubes, the open ends being sealed by foils and the tubes evacuated separately; after sealing together the dividing foils are punctured by means of the electron beam. A short description is given of a compact cascade h.v. generator producing 1000 kV. A number of absorption curves in Cu have been obtained at voltages between 400 and 600 kV. The half-value layers obtained are in good agreement with those of Mayneord and Roberts but show considerable discrepancies from those of Taylor and Singer. It is shown that mere increase of Cu filtration will not give a half-value layer greater than 6·5 mm. Cu at 600 kV. Using heavy element filters such as Pb and W, however, half-value layers up to 8·5 mm. Cu can be obtained. J. E. R.

4392. Distribution of γ-Radiation in Human Tissues by Radium Teletherapy. C. W. Wilson and G. Myers. *Brit. J. of Radiology,* 9. *pp.* 379–389, *June,* 1936.—A series of measurements by Sievert's condenser chamber technique of the dosage, due to the 2-gm. radium bomb at Westminster Hospital, within a human cadaver are described and compared with similar measurements within a water phantom. It is shown that for sites extensively surrounded either by water or by human tissue, the dosage is identical. For regions near the boundaries of tissues, however, the dosage measured is different from that in an extensive water phantom. It is suggested that for such regions a volume of water (or other phantom material) should be used, equivalent to that part of the body undergoing irradiation. In the irradiation of brain tumours it appears that the removal of the bone of the skull enhances the depth dose by 12–13 %. AUTHORS.

***4393. Easily Demountable Unit for Teletherapy. W. G. Evans and H. D. Griffith.** *Brit. J. of Radiology,* 9. *pp.* 390–399, *June,* 1936.—A design for a radium bomb is discussed, the charge being composed of radon combined with radium element in needles and tubes. The isodose distribution is given and protection conditions have been investigated. Comparative measurements of the depth dose in air and in wax are given. The optimum dosage-conditions, clinical reaction to irradiation, and depth in tissue which can be effectively irradiated by the unit are described. AUTHORS.

***4394. Detection and Consequences of Defects in Radium Needles. H. D. Griffith.** *Brit. J. of Radiology,* 9. *pp.* 404–411, *June,* 1936.—Examples of badly packed radium preparations are discussed. The magnitude of the resulting irregularities of tissue dose is investigated, and compared with results computed from quantitative study of autoradiograms. AUTHOR.

***4395. Electrocardiophone for Teaching Purposes. L. B. Rentschler.** *Science,* 82. *pp.* 627–628, *June* 26, 1936.—The electrocardiophone described is suitable for making heart sounds audible in a medium-sized lecture room. A bell-type stethoscope is connected to a piezoelectric Rochelle salt crystal microphone, and the resulting vibrations amplified by means of a 5-stage valve amplifier, and reproduced in a loud-speaker.

Some details of the stages of the amplifier are given. The chief advantage of the instrument is that normal and pathological heart sounds can be heard by a large number of students simultaneously, with the patient in full view. J. E. R.

See also Abstract 4204.

OSCILLATIONS AND WAVES.

***4396. Electric Arcs : Hg Arc Generator. H. Scharff.** *Hochfrequenztechn. u. Elektroakustik*, 48. *pp.* 22–32, *July*, 1936.—Research was undertaken to investigate the suitability of the Hg arc, with parallel oscillatory circuit, as a source of h.f. oscillations. It was found that such oscillations of approximately constant frequency are only obtained when the arc is fixed by introducing H at a suitable pressure into the discharge chamber. Fixation of the arc was found possible with other gases, such as A and N, but with these no h.f. oscillations were obtained in the oscillatory circuit. With the experimental arrangement employed strong oscillations were obtained on wave-lengths down to 800 m., with similar operating conditions to those used for the Poulsen generator. Below 800 m. the oscillations were weaker and no oscillations of wave-length less than 300 m. could be obtained. Oscillations of all three kinds were obtained with different experimental conditions. By short-circuiting the oscillatory circuit inductance " Kipp " oscillations of higher frequency ($0 \cdot 5$ to $1 \cdot 0 \times 10^6$ per sec.) could be obtained. Plasma oscillations were also observed, the wave-length lying between 1000 m. and 2400 m., with maximum amplitude at 1600 m. The plasma oscillations are quite independent of and unaffected by the arc oscillations in the oscillatory circuit. A. W.

***4397. D.C. Amplifier. A. M. Monnier and J. Bazin.** *Comptes Rendus*, 202. *pp.* 2052–2054, *June* 22, 1936.—A d.c. amplification stage is described which admits of the use of common batteries with a common point at the kathode for all stages, and of the direct connection of the output terminal of any stage to an external instrument. T. I. J.

4398. Oscillations of an Electric Circuit in a Radiation Field. E. Hallén. *Nova Acta Regiae Soc. Sci. Upsaliensis*, 10. 2. [40 *pp.*], 1936.—An important mathematical paper which does not lend itself to brief abstracting. The simple theory of a coil aerial assumes that the current due to the field has the same value all along the coil at any instant. In the more general case, however, especially as the frequency increases, this is not true. The author has previously dealt with this problem and this paper is an extension of the work. [See also Abstracts 1351 and 1352 (1934).] F. S. B.

***4399. Reception of Decimetre Waves. E. C. Metschl.** *Naturwiss.* 24. *pp.* 433–437, *July* 10, 1936.—For measurements in the neighbourhood of a decimetre-wave transmitter a crystal detector has been found very effective, a tantalum point being used against a silicon plate and the detector arranged at the centre of a half-wave dipole. A vacuum thermal junction using constantan and chromium wires of thickness about 200 μ was also found reliable used in the same way as the crystal detector. Discussion of the practical difficulties attendant on reception of decimetre waves at a distance leads to the conclusion that the best type of receiver hitherto developed for this purpose is the retarded-field audion, though this gives by no means a complete solution of the problem of reception of decimetre waves. Whether the superheterodyne principle can be successfully applied to reception of wave-lengths of the order of 10 cm.

appears to depend very largely on further development of valve technique. [See also Abstract 1887 (1936).] A. W.

4400. Propagation of Electromagnetic Waves in an Anisotropic Bicomplex Medium. B. Ferretti. *N. Cimento,* 13. *pp.* 164–179, *April,* 1936.—The author extends to the case of anisotropic media, Arkadiew's concept of a bicomplex medium in which the electric and magnetic inductions are not in general proportional to the corresponding forces but, in the case of harmonic oscillations, exhibit a certain lag, amplitude and angle of lag depending on the frequency. The equations of electromagnetic wave propagation in a medium of this type are developed. The propagation of plane waves and their reflection at a surface separating an anisotropic bicomplex medium from empty space are studied. W. S. S.

4401. Recent Experiments Confirming a New Interpretation of Refraction in Conditions of Total Internal Reflection. G. Usiglio. *Accad. Lincei, Atti,* 23. *pp.* 345–351, *March* 1, 1936.—Beauvais' experiments on the electromagnetic disturbance in the second medium when 18-cm. radio-waves are totally internally reflected in a paraffin prism, are shown to support the author's model for the interpretation of refraction and total internal reflection. W. S. S.

4402. Refraction of Electromagnetic Waves with Special Reference to Total Internal Reflection. G. Usiglio. *N. Cimento,* 13. *pp.* 180–193, *April,* 1936.—The author discusses the physical interpretation of the electromagnetic theory of refraction of a plane wave at an interface between two dielectric media with special reference to the disturbance in the second medium when total internal reflection occurs. W. S. S.

4403. Radio Investigations in the Ionosphere. I. Ranzi. *Elettrotecnica,* 23. *pp.* 350–357, *June* 25, 1936.—The author passes in review the methods employed for investigating, by means of electromagnetic waves, the conditions in the ionosphere, and explains the results obtained to date regarding the structure of the ionosphere itself and the causes of its formation. J. E. B.

4404. Simultaneous Echo Measurements at Distant Stations. W. Crone, K. Krüger, G. Goubau and J. Zenneck. *Hochfrequenztechn. u. Elektroakustik,* 48. *pp.* 1–7, *July,* 1936.—Simultaneous echo measurements by the impulse method, with vertical transmission from similar apparatus, were made at two stations a few hundred km. apart. Observations were also made of signals transmitted from one station and received after a single reflection at the other. A detailed account is given of the relations between the behaviour of the ionosphere at the two stations and of the phenomena observed in connection with transmissions by single reflection between the stations. The wave-lengths used were about 50 m. and 80 m. A. W.

4405. Abnormal Ionisation of the Ionosphere. F. Schultheiss. *Hochfrequenztechn. u. Elektroakustik,* 48. *pp.* 7–21, *July,* 1936.—In the change-over from reflection by the abnormal E-layer to the F-layer or *vice versa,* variations of height of neither layer are observed, but it has been found that for a considerable time strong reflections may be obtained simultaneously from both layers. Under some conditions a large range of wave-lengths (46–220 m.) may be reflected by the abnormal E-layer. When total reflection occurs it must be concluded that the gradient of the electron concentration on the underside of the normal E-layer is extraordinarily high and it follows that the maximum carrier concentration of the abnormal E-layer can be greater than the maximum day concentration, not only of the normal E-layer, but also of the F-layer. No such conclusions can be drawn when partial reflection is in question. A whole series of phenomena can be most simply explained by the assumption that the ionisation of the abnormal E-layer is very irregular. Abnormal E-ionisation was observed during the day for about 30 % and during the night for about 27 % of the observational time. With regard to the occurrence of abnormal E-ionisation there appears to be no specially favoured time during either the day or the night. Intermediate reflections are only observed with abnormal ionisation. The records lead to the conclusion that in such cases the abnormal E-layer has quite a small thickness and possesses at its upper side also very high carrier concentration gradients. The effective height of reflections from the F-layer is in no way affected by the occurrence of abnormal E-ionisation. A. W.

4406. Natural Frequencies of Ionised Gases in a Magnetic Field. T. V. Ionescu. *Comptes Rendus*, 203. *pp*. 57–59, *July* 6, 1936.—Two cases are considered; (*a*) where the density of the ions Np is equal to that of the electrons Ne and (*b*) where Np is > Ne. In both cases it is found that in the presence of a magnetic field two natural frequencies occur, for which formulæ are derived. The first case may frequently be found in h.f. excitation with exterior electrodes, in the ionosphere, etc., and the second corresponds with the case of the positive column of a Geissler tube discharge. A. W.

4407. Constitution of the Ionosphere. R. Jouaust. *J. de Physique et le Radium*, 7. *pp*. 289–296, *July*, 1936.—A summary of results to date. The conclusion is reached that the ionisation is due largely to the u.v. rays, and the disappearance of electrons to recombination of positive ions. R. M.

***4408. Valves and Rectifiers. Part I. H. Rukop.** *Die Physik*, 4. 3. *pp*. 107–130, 1936.—A summary is given of the work on valves and rectifiers. In Section I the principles and construction of transmitting valves are described; in particular, transmitting valves of great power, screened-grid valves, pentodes and valves for short-wave work are considered. In Section II various types of amplifiers for long and medium waves, chiefly for use in broadcasting are described. The part played in high vacuum tubes by secondary electrons is discussed in Section III. Electron-ray tubes and the principles of electron optics and a brief reference to rectifiers are dealt with in Sections IV and V. Throughout, a concise summary of the most recent work, with references to the originals, is included. H. J. H. S.

See also Abstracts 4088, 4091, 4151, 4363.

PHOTOELECTRICITY.

4409. Use of Image Potential for the Surface Photoelectric Effect. R. D. Myers. *Phys. Rev.* 49. *pp*. 938–939, *June* 15, 1936.—The surface photoelectric effect in metals is calculated taking account of the image force between electron and metal. The result is an increased number of slow electrons and a somewhat steeper maximum of the photoelectric effect as a function of the illuminating frequency. No agreement with experiment is obtained because the reflection and refraction of the light has not been taken into account. AUTHOR.

***4410. Optical Constants of Potassium. H. E. Ives and H. B. Briggs.** *J.O.S.A.* 26. *pp.* 238–246, *June,* 1936.—A study is made of the optical constants of K in the u.v. region. In addition to the usual Babinet compensator between crossed Nicols a pair of quartz wedges, the one of right, the other of left rotary quartz, mounted to form a plane parallel plate, are placed between the Babinet and the analyser with the wedge edge perpendicular to the wedge edge of the Babinet. Viewed through the analyser the field shows a double rectangular array of dark spots, one array consisting of those points where the plane polarised light suffers a rotation of 0, $\pm \Pi$, $\pm 2\Pi$, etc., the other of those points suffering rotations of $\pm \Pi/2$, $\pm 3\Pi/2$, etc. If the azimuth of the incident light is changed one array is shifted up, the other down; if the phase is changed both arrays are shifted in the same direction by equal amounts. Experimentally, the positions of these spots are determined and the refractive index and extinction coefficients calculated from these observations. The observations cover the range $\lambda 5780$ to $\lambda 2536$. [See following Abstract.] A. H.

4411. Calculated and Experimental Photoelectric Emission from Thin Films of Potassium. H. E. Ives and H. B. Briggs. *J.O.S.A.* 26. *pp.* 247–250, *June,* 1936.—Results already obtained [see preceding Abstract] are compared with theory. It is expected that there will be a very sharp maximum at $\lambda 3400$ for light polarised with the electric vector parallel to the plane of incidence. It is found that the experimental peak is shifted to the red by amounts up to 200 Å, and that the theoretical and experimental curves agree well on the short-wave side but not on the long-wave side, where there is an additional maximum at $\lambda 4000$. It is believed that this discrepancy is due to the presence of gas. There is also expected an extremely small emission for light polarised with the electric vector parallel to the surface. This is believed to exist but cannot be accurately checked because of scattered light. The phenomena obtained with K in bulk are also briefly considered. A. H.

***4412. Composite Transparent Photoelectric Kathodes. P. Görlich.** *Zeits. f. Physik,* 101. 5–6. *pp.* 335–342, 1936.—It is shown that with a transparent photoelectric kathode of Cs alloyed with Bi a long-wave maximum is present which does not appear when the same material is deposited on metal. If the transparent kathode is sensitised by a hydrogen discharge this maximum is shifted towards longer wave-lengths. The position of the maximum is not always the same for differently sensitised kathodes but is constant for unsensitised kathodes. With sensitised kathodes the position of the long-wave maximum may not be the same for light passing through the kathode to the emitting surface as for light falling directly on the emitting surface, but the position of the threshold is the same. Several different metals were alloyed with the Cs, with similar results; the quantum output is greater the less the conductivity of the alloyed metal. D. H. F.

***4413. Time-Lag in Photoelectric Cells. N. R. Campbell, H. R. Noble and L. G. Stoodley.** *Phys. Soc., Proc.* 48. *pp.* 589–604; *Disc.,* 605, *July* 1, 1936.—In a previous paper [see Abstract 5226 (1932)] it was shown that the behaviour of a cell immediately after exposure to light, or immediately after extinction of the illumination was consistent with the assumption that the time-lag in the response arose wholly from processes following a single instantaneous light impulse and not from the interaction of successive impulses. In the present work the authors find that the results previously reported were exceptional and not typical.

They find that the assumption is not valid, and that low-frequency time-lag is largely due to interaction of successive pulses. Experiments were made to attempt to find out how time-lag is affected by the size of the cells but the results were inconclusive. The very small time-lag of argon-filled cells with sensitised potassium kathodes was found to be due to hydrogen evolved from the kathode. The distinction between h.f. lag, due to the finite velocity of the ions, and the l.f. lag now being investigated is pointed out and discussed in the final section of the paper. J. W. T. W.

4414. Photoelectric Conduction in Rock-Salt under Ultra-Violet Illumination. P. Tartakowsky and W. Poddubny. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 407–412, 1936. *In English.*—The formation of a space charge by photoconduction of rock-salt crystals with U-centres under u.v. illumination is studied. The electrons forming the space-charge are bound to two different energy-levels; the higher coincides with the I′ level already known, the position of the lower has not yet been determined. It must lie near or coincide with the U-level. AUTHORS.

4415. Theory of Photo-E.M.F. in Semi-Conductors. L. Landau and E. Lifshitz. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 477–503, 1936. *In English.*—The e.m.f. that appears in a circuit containing a semi-conductor illuminated from one side is calculated. Two cases are regarded; a semi-conductor with conducting electrons and a semi-conductor with conducting electrons and "holes." AUTHORS.

4416. Action of X-Rays on Cuprous Oxide Blocking-Layer Photoelectric Cells in a Vacuum. A. N. Kronhaus. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 461–465, 1936. *In German.*—Cu_2O blocking-layer photoelectric cells, when irradiated with X-rays, give an e.m.f. which is proportional to the intensity. Hitherto the difficulty in the way of using cells of this type for measuring X-ray doses has been the gradual "ageing" effect, whereby the sensitivity falls off about half its original value in 2 or 3 months. The present paper describes the results of attempts to eliminate this gradual change. Covering the cell with a transparent surface coating is found to be unsatisfactory. Placing the cell in an evacuated vessel is found to reduce the sensitivity both for visible and for X-radiation, but no appreciable "ageing" effect can be detected after 1 month. L. A. W.

***4417. Photoelectric Photography. A. Lallemand.** *Comptes Rendus,* 203. *pp.* 243–244, *July* 20, 1936.—Apparatus is described whereby photoelectrons are registered photographically. The arrangement is analogous to that employed in electron optics. A. H.

See also Abstracts 4010, 4042, 4145, 4151, 4333, 4363, 4388.

PIEZOELECTRICITY.

***4418. Piezoelectric Resonator and Effect of Electrode Spacing upon Frequency. W. G. Cady.** *Physics,* 7. *pp.* 237–259, *July,* 1936. —The "mechanical" theory of the crystal resonator with gap between crystal and electrodes is developed from first principles, and an explanation of increase in resonance frequency with increasing gap is obtained. For those types of vibration for which the crystal faces are equipotential surfaces, the results are in agreement with those obtained by the "electrical" theory which makes use of the ordinary electric network equivalent of the crystal. But the mechanical theory, unlike the electrical theory, describes correctly the performance of crystals even when the faces are not equipotential surfaces. Measurements made with 8 quartz resonators gave results differing from the theoretical results by from 13 % to 60 % with small gaps. With large gaps the discrepancies were as a rule larger. The probable reasons for these discrepancies are discussed, with the conclusion that a large increase in frequency with gap may be taken as a criterion of a good resonator. P. V.

4419. Production of Piezoelectricity by Torsion. R. E. Gibbs and Ling-Chao Tsien. *Phil. Mag.* 22. *pp.* 311–322, *Aug.*, 1936.—The production of piezoelectricity by torsion is considered for the case of right circular cylinders of quartz cut with their axes parallel to the optic axis. The experimental observations of other experimenters are shown to agree with the theoretical formula deduced. The Lindemann electrometer is shown to be suitable and very convenient for the study of piezoelectricity, and is used to demonstrate experimentally the static development of volume charges. Torsional oscillations are produced in both hollow and solid cylinders, and are studied by the glow discharge, dust, and polarised light methods. AUTHORS.

4420. Influence of Temperature on the Frequency of Piezoelectric Oscillations. G. Michailov. *Techn. Phys., U.S.S.R.* 3. 6. *pp.* 511–518, 1936. *In English.*—The influence of temperature on the natural frequency of crystals of Rochelle salt and certain isomorphous salts is investigated. An abrupt change in the relation is found at $T = 22 \cdot 5°$ C. The temperature coefficients over the ranges 10° to 22° C. and 23° to 35° C. are calculated from the curves $n = f(T)$. The coefficient in the first temperature range is four times greater than in the second. The temperature coefficient in the second range is approximately equal to that of the isomorphous crystals. The relation $n = f(T)$ is linear for the isomorphous crystals over the temperature interval 0° to 30° C. AUTHOR.

See also Abstracts 4296, 4298.

THERMIONICS.

4421. High-Temperature Properties of Niobium. A. L. Reimann and C. K. Grant. *Phil. Mag.* 22. *pp.* 34–48, *July*, 1936.—To obtain a clean surface of the metal speedily a new vacuum technique is employed and in addition to measurement of the electron emission from the filament after reaching a final steady state, measurements of the specific resistance, total thermal radiation, and the rate of evaporation of the metal as function of the temperature in the range 1800° to 2400° K are recorded as also the melting point of the niobium. Experimental procedure and supporting theory are given. The value of the melting point found to be consistent with the conditions of experiment is 2707° K. The latent heat of evaporation (internal) is 171,200 cal./mol. Allowing for the roughness factor the value of " A " for the thermal electron emission is given as 29 A. cm^{-2}. deg^{-2}. over the range measured. The results are in good agreement with theory and are compared with those of Wahlin and Sordahl. S. G. B.

4422. Thin Film Field Emission. L. Malter. *Phys. Rev.* 50. *pp.* 48–58, *July* 1, 1936.—It is found that if a primary electron beam impinges on Al_2O_3 treated with Cs and O_2, a current flows to a positive collector; this in certain cases is many thousand times greater than the primary current. The electron- (and possibly ion-) emission from the film increases with collector voltage and beam currents, obeying power laws but exhibiting saturation tendencies. There is a rather slow decay after the primary current is stopped since surface charge takes time to leak away. Time lags also occur when current is applied, and light sensitiveness is seen in decrease of field emission and speeding up of decay. Other surfaces, with a few exceptions, do not show this effect. H. M. B.

4423. Influence of Flow Plane Traces on Thermionic Emission. H. Mahl and D. Schenk. *Zeits. f. Physik*, 101. 1–2. *pp.* 117–120, 1936.—Electron microscopic observations of hot kathodes show that sometimes a series of parallel lines (due to differences in specific emission) may appear. A number of photographs of a Ni kathode subjected to Ba vapour show light streaks (strong emission) on some of the crystallites ; these disappear in time. A W kathode activated with Th shows dark (weak emission) lines. On prolonged heating the latter disappear (at 2500° K) and the usual structure of a thoriated W kathode is obtained, visible streaks in the position occupied by the former emission lines being noticed. Suggestions are made to account for the origin of these lines. [See also Abstract 2457 (1936).] H. J. H. S.

4424. New Source of Alkali Ions. J. Koch. *Zeits. f. Physik*, 100. 11–12. *pp.* 669–684, 1936.—An easily produced anode of large equipotential surface and free from slow degassing is described for the production of beams of alkali ions. The active material is a mixture of tungsten powder and the alkali chloride, with external heating. With potassium a current density of $3\cdot 6 \times 10^{-6}$ A./cm.^{2} can be maintained for 36 hr. Examination of the ion beam with a Thomson mass-spectrograph showed Cs, Rb and K to yield the purest ion beam. [See following Abstract.] F. C. C.

4425. Emission of Positive Cs Ions from an Externally Heated Tungsten Surface. J. Koch. *Zeits. f. Physik*, 100. 11–12. *pp.* 685–701, 1936.—The liberation of electrons and the reflection of Cs ions from an externally heated tungsten surface is examined [see preceding Abstract]. The ionic reflection is very marked and the accumulation of ions on the surface produces changes in the properties of the latter. " Saturation " is produced when the sheet is $0\cdot 1$ atom thick. Rapid heating of the surface causes these atoms to be emitted as positive ions. A determination is also made of the number of electrons liberated from a Ni surface impregnated with Cs. F. C. C.

See also Abstracts **3922, 4179, 4315.**

THERMOELECTRICITY.

4426. Thermo-E.M.F. in Metal/Semiconductor/Metal Elements. Part I. G. Mönch. *Ann. d. Physik*, 26. 6. *pp.* 482–494, *July*, 1936.—Measurements on different Cu-Cu_2O-Cu elements of the temperature-dependence of the conductivity and the thermo-e.m.f. are given. Theoretical considerations are developed, based on the volume thermo-effect in the semiconductor and the thermo-e.m.f. occurring at the boundary of the metal and semiconductor. The observations are compared with theory, and it is shown that the relative importance of the volume and the boundary components of the observed thermo-e.m.f. depends on the kind of test applied. Supposed disagreements between theory and experiment found by Joffé are explained. D. H. F.

See also Abstract **4327.**